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The Advantages of Flushing in Coal Mining

Introduction of Filling into Mines Is an American Idea Much Favored in Europe. The System Is Necessary at Some Mines with Bad Top

BY LUCIUS W. MAYER*

The practice of back-filling waste material into underground workings by means of water, is called "flushing" in America. This idea of so conducting material is of American origin, having been first introduced in Pennsylvania about 17 years ago. James B. Davis of the Dodson colliery first worked on the scheme in 1891 at the property of the Dodson Company in Plymouth, Penn., near Wilkesbarre. Up to the year 1907, there had been no decided change in the original method of filling, and the company was still drawing from its waste-culm pile to fill the mine chambers. At the Black Diamond colliery, which was under the management of the Jno. C. Haddock Coal Company, similar operations have been in vogue for some time. The Lehigh Valley Coal Company as well as the Pennsylvania & Reading Coal & Iron Company have not been slow in adopting the idea at a number of points in the State.

Information on the subject does not evince the idea that the flushing system is used elsewhere in the United States than in the State of Pennsylvania. Not many years after the announcement of results at the Dodson colliery, German engineers investigated the field where the process was in successful operation, and have since illustrated their approval of the practice by its universal introduction along most elaborate lines in Germany, where it continues to gain favor constantly.

Value of the System has been Proved

The value of the flushing system as used in Pennsylvania has been proved beyond question. At the Dodson colliery, it is questionable whether the property could be successfully worked were it not for filling the excavated areas. This is not alone accountable to the squeeze which was impending, but also to the nature of cover which overlies the thick seams, and the fact that the coal lies to a great extent directly under the main town. A similar condition existed at Shenandoah City, Penn., where chambers of large extent have been filled to maintain surface structures.

In Upper Silesia, Germany, where the system was first introduced in Europe, damage suits were numerous as a result of surface depression caused by the underground excavations. The seams in this field (often attaining 25 ft.) are very thick, consequently the subsidence was severe, and any economic system of mitigating this condition was welcome. The water-filling method has become popular in Silesia because of the extremely favorable results attained with it. Any material in the district (such as gravel, clay, crushed slag, cinders, etc.) which can be moved with water and passed through ordinary sized pipes, is introduced into the workings. Since the adoption of the method, surface damage suits have practically disappeared.

Pillar coal hitherto unminable because of permanent pillar requirements, is now available, and timber costs have been considerably reduced. Surface troubles have been greatly alleviated, and work underground is now carried on under much safer conditions.

It might be pointed out at the beginning, that the general system as operated in America is rather more with a view of maintaining ground, i.e., reinforcement of the pillars, than as a means of extracting pillar coal which otherwise would be left in place. In Europe, the incipient idea is

FIG. I. CONVEYING FILLING FROM DUMP

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to effect a complete removal of the deposit; the preliminary layout of the mines is planned with this prospect in view, whether the mining system is pillar work or modified longwall. In justice to the originators of the flushing system, it is only fair that a description be first offered of the practice at certain points in Pennsylvania, but it must be admitted that in Europe the practice has received much more attention and use than in America. This applies in Europe to metalliferous mines as well as coal mines.

Flushing at the Dodson Colliery

Fig. 1 illustrates the general surface arrangements at the Dodson colliery at Plymouth Penn. The culm dump is represented by *a* and shows in the foreground, although much of the material has since been transferred to the mine workings. The old breaker is marked *b*.

The culm dump in the figure is composed of material which was mined many years ago. This contains a good quantity of coal which in former days was not marketable. *c* is the small washery which now rehandles the dump as a whole, and extracts the good product as it is received from the conveyer *d*. This latter is a conveyer of the push-plate type. The trough at *d* in Figs. 1 and 2 shows the chain and push plates leading up to the engine *f* Fig. 1, at which point the material is directed at right angles to a second conveyer *h* delivering to the washery. The two conveyers measure 680 ft. in length. Fig. 2 shows a section of the conveyer in detail, and the method used for feeding same. The troughs were of No. 10 sheet lining in 4-ft. lengths, the shape being half hexagons. The frame sections were 12 ft. in length. As the culm bank is consumed the conveyer is moved up accordingly.

At *c* Fig. 1, the filling is joined by the waste coming from the main washery, and a supply of water, and is thus conducted down the launder *g* of Figs. 1 and 3. The material leaving the washeries will all pass through a ⅜-in. ring. The flume is about 650 ft. long and is lined with terra cotta-pipe sections. This flume leads to the bore-hole well, into which the culm may be seen discharging in Fig. 4. Over the hole a tripod is seen. The function of this apparatus is to support rods which are at times brought into play when the hole becomes jammed. The cover which fits over the well casing is marked *k*.

The bore-hole is 8 in. in diameter and 600 ft. in depth; it is lined with 5-in. wrought-iron pipe, the space between the outer periphery of the pipe and the hole being filled with mud. The system of pipe connections underground where the pipe line starts off from the vertical, is shown in Fig. 5. This is the 360-ft. level. The three valves shown control the direction of flow at this point. Upper valve *l* is a drain cock; if *m* is shut off and *l* opened, a drain of the system is effected. It is important that the system be drained at times when operations cease, or if flushing is to be discontinued at a lower level, and an upper level is to be started. The arm *o* in Fig. 5 is part of the casting and extending out serves as a bearing against the timber prop, noticed in the illustration.

Pipe Lines Underground

The pipes are laid along the gangways and branch off by means of elbows and tees leading into the mine chambers; 4- and 5-in. pipes are used underground. Experiments were carried on some time ago at the Dodson colliery to test the various pipe materials. It was found that wrought iron gave the best service; that the steel pipe tried, was too soft, and that cast iron wore rough inside. At the time of my visit, culm was passing through about 1500 ft. of pipe and there was considerable up-grade in the course of the line. Three hundred and fifty tons of culm was being flushed per 18 hours and the water flow was given at 485 gal. per min., or approximately 5 to 5.5 lb. of water per lb. of culm.

The Mine Workings

The Dodson mine comprised seven seams of coal showing a variety of thicknesses ranging from 5 to 23 ft. The method of working was by the bord-and-pillar system though not with the utmost regularity, the pillars necessarily varying in size in different parts of the mine. The seams pitch slightly, although at some points they are quite horizontal. Where there is grade to the workings, the pipe enters the chambers from the upper end, the culm thus banking up to the roof at the lower end, where a barrier has been set to hold the culm intact and allow the water to pass on. Where the floor is level, the pipe is carried into the chamber to its full length, and the discharge end is set close to the roof. As the chamber fills, lengths of pipe are gradually withdrawn. It seems difficult to conceive how a chamber having a level floor and roof can be completely filled in this way, and it would appear that where a close contact is effected between the filling and the roof under such conditions it must be due to the bend of the roof between pillars.

Barriers

Previous to the introduction of the filling into the chambers, the areas are isolated by timber walls which serve to control the inflow of culm. The hight of barriers varies with the thickness of seam. Fig. 6 shows the form generally used. Vertical round posts are set off at 4- to 6-ft. intervals across the mouth of the chamber. These posts are 6 to 12 in. in diameter and are set into hitches previously cut in the floor and roof to receive them.

Where the pitch of the seam is slight,

FIG. 2. FILLING ON ITS WAY TO BORE-HOLE

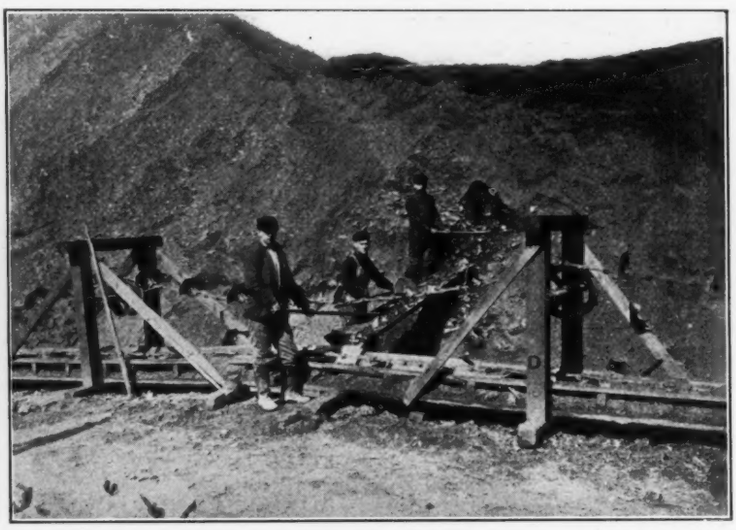

FIG. 3. LOADING CONVEYER

relatively little pressure must be sustained by the barriers, but in the more inclined seams it often becomes necessary to reinforce these posts by additional timbers, or by placing a rock-wall on either side of the timber barrier wall. In order to allow the water to drain off from the mass of the culm as it comes to rest, small holes are bored in the planks making up the wall. This same form of barrier may be varied by using round timber throughout instead of plank.

Referring to Fig. 7, this shows a form of barrier maintained by planks which become imbedded in the filling material; these planks are attached to the barrier wall, and the entire arrangement is self-sustaining. The wall is formed of 2x12-in. planks, 12 ft. long, designated by *a* in the figures. Planks *b b* are engaged into this wall at right angles to it, and at a vertical interval of 12 in. The filling backs against the wall *a*, and at the same time accumulates about the *b b* planks.

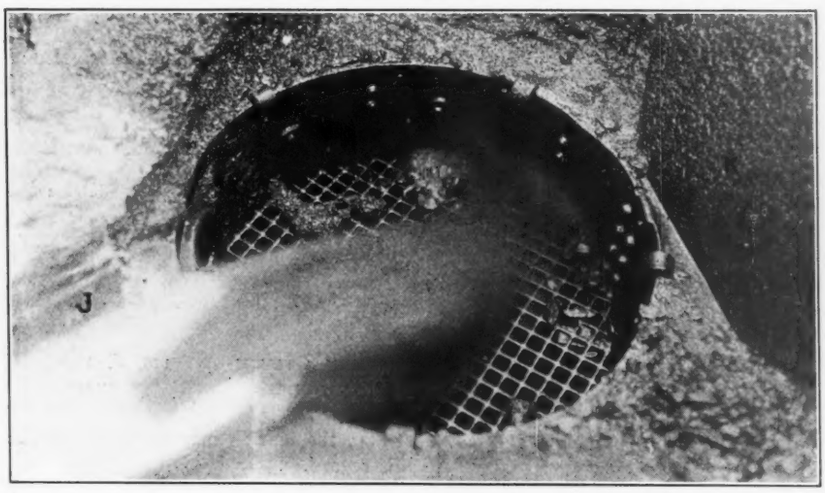

FIG. 4. BORE-HOLE WELL RECEIVING FILLING ON SURFACE

The imbedded planks and the wall are secured by means of 2x2 or 2x4-in. cleats *c c c*. The wall may be built to any desired hight. The sticks *d d* are simply placed to hold the *b b b* planks apart while the filling accumulates.

The advantage of such a type of barrier is its flexibility, and hitches do not have to be cut in the roof and floor as in the post type. A comparative estimate of cost for the two types, including installation, shows that up to about 8 ft. hight, the sectional style is the cheaper of the two.

Fig. 8 illustrates a typical area in the William A mine of the Lehigh Valley Coal Company in Pittston, Pennsylvania. It is noted that the area to be filled is equipped with barriers and that the filling is sent in from the upper gallery. The general method underground is quite the same as at the Dodson colliery. The filling material, culm, came direct from the washery and there was but one lift in the bore-hole. At this lift there was a large L fixture which changed the direction of culm flow from the vertical, and the pipe line was started off at an upgrade so that an accumulation was always present at the L to act as a cushion to the down-flowing stream. The culm particles were considerably larger than the average at Dodson, quite an amount of material as large as 2 in. being noted. This is not unusual, for large sized gravel is being flushed at another point in the district, where the material is only small enough to pass through the 4-in. pipe.

At the Hazleton No. 2 mine there is arranged an L at the bottom of the bore-hole line, of design shown in Fig. 9. To effect a tight connection, grout was forced up into the space between the pipe and the walls of the bore-hole. The fixture is supported by a base marked *r*. Wooden pipe of the design shown in Fig. 9 was used at this mine and served well to counteract the corrosive effect of the mine waters on ordinary metal pipes.

European Flushing Practice

The Myslowitz colliery at Myslowitz, Upper Silesia, is reputed to be the first European mine to introduce the flushing system known in Germany as "spielversatz." This colliery is one of the larger operations of the foremost German coalfield. The idea of introducing filling with water soon traveled westward and southward, and it was not long before it was practiced in Westphalia, several districts in France, and also in Austria on an elaborate scale.

The replacement of coal seams with filling had long been realized a necessity in many parts of Europe, and its introduction became so urgent a requirement, that manual labor was pressed into service for the purpose of transferring great volumes of dry material from banks on the surface, and placing it in the mine chambers. In fact, at the present time, in various parts of Europe, dry filling is lowered into mines and shoveled into place behind the coal face; in spite of the expense of hand-loading at the bank and similarly unloading at the face, the practice has been found economical in the long run.

Water flushing is gradually replacing all other methods of filling transference, and it has been universally found that this method far surpasses the dry method from many standpoints, not alone in the matter of manipulation cost, but more particularly in the matter of efficiency in fulfilling the purpose of the filling.

FIG. 5. PIPES ENTERING MINE WORKINGS AT BORE-HOLE

In using water, the problem of its disposal after having served its purpose as a conductor, must not be minimized, and where this water must be raised from the mine workings, it must be clear to a degree, before being allowed to enter the pumps. These items, in addition to plant requirements on the surface to control the inflow of material as it is brought to the bore hole or shaft, must be considered, in comparing the flushing system with other methods.

Most interesting operations carried on in southern France will be described in detail later on. Suffice it to say that at Carmaux, dry filling has for a long time been practiced, but is now being replaced by a successful flushing system. The new system has met with distinct favor already, it having been found that the shrinkage in volume of material hydraulically filled is markedly less than where the sand and clay was introduced dry, which,

of course, infers amelioration of the objectional surface subsidence feature.

Flushing in Metal Mines

Not alone has flushing been adopted in coal mines of Europe, but in Germany I observed a lead mine where mill tailings were being flushed to great advantage, and at another point, also to be described, an iron mine had introduced a chamber-and-pillar system of mining, in which was involved the flushing of sand, in virtue of which pillar removal was made possible.

In Cumberland, England, flushing of sand into an iron mine to assist a contemplated scheme for the removal of large pillars was under consideration. The deposit was a high grade of ore, and at this particular mine the caving system (so prevalently practiced in Cumberland), involving lowering of the surface, was not adoptable. I have no record of any other mine in England where steps have been made to introduce filling by flushing, but various English engineers have visited the Silesian field in Germany, with a view of investigating the flushing practice there.

The difficulties involved at times in obtaining water for the purposes herein described, as well as the disposal of same from the workings in a clarified state, has suggested possibilities in the direction of utilizing air under pressure as a motive medium for the stowage material. An experimental plant was recently constructed near Kattowitz, Upper Silesia, to experiment with the idea of introducing filling from the surface to the mine chambers, with compressed air as a conductive force. At the time of my visit in Silesia, during September, 1907, the experiments had not been brought to a conclusion, but sufficient work had been carried on to predict a fair future for the process, in view of the encouraging results thus far attained.

Air as a Conductor

The material which had been experimented with was a crushed dolomite rock, and I was advised that material as large as 1 in. had been satisfactorily manipulated. Pipes were about 10 cm. in diameter. Following the phenomena of acceleration and velocity of air and solids in pipes, it was found best to make the pipe line which conducted the material in its vertical course down the shaft, of spiral design. It was inferred from the information available that only a light air pressure was necessary, and that the pipe lines underground could be varied at will in direction, to make turns or follow undulations of the floor. The information was evinced, that by this air-filling system, more or less of a dust nuisance was created in the mine chambers as the material discharged from the pipe line, and that the process involved a higher cost than flushing, where water was readily available.

It would appear that with any system not involving water, it would be difficult to create a very intimate contact between the particles making up the filling medium. It has been suggested that this involves a condition allowing of excessive shrinkage of the packing and consequent subsidence of the overlying strata. It is my opinion, however, that with the air system less shrinkage is likely than where the stowing is introduced by shoveling, although unless the air pressure under which the particles are introduced is strong, the margin may be very small in this regard.

At the Park Pit, Skelton Cumberland, a method of building dry rock-walls in certain parts of the mine has been introduced, and within these walls which are about 1 to 2 ft. thick and built more or less on the pig-stye order, small stuff is packed. The walls are built up to the back, and similarly the loose material is piled up within the skeleton walls. As the loose stuff is placed, sprays of water are added thereto, and the whole tamped as the building up progresses. In this way quite a consistent pack is accomplished, and no more water is introduced than can be absorbed by the filling, so that no water-disposal troubles enter into the problem. The operations on these lines were not very extensive, and were intended merely to counteract surface subsidence at certain points where buildings were located.

At Lens, Pas de Calais, which is in northern France, an inclined seam is back-filled by *remblayage par embouage*, as flushing is called in France. Here, however, the filling material, which is a shale, is lowered to a certain gallery in the mine in cars, where it is dumped into storage receptacles, and on leaving same

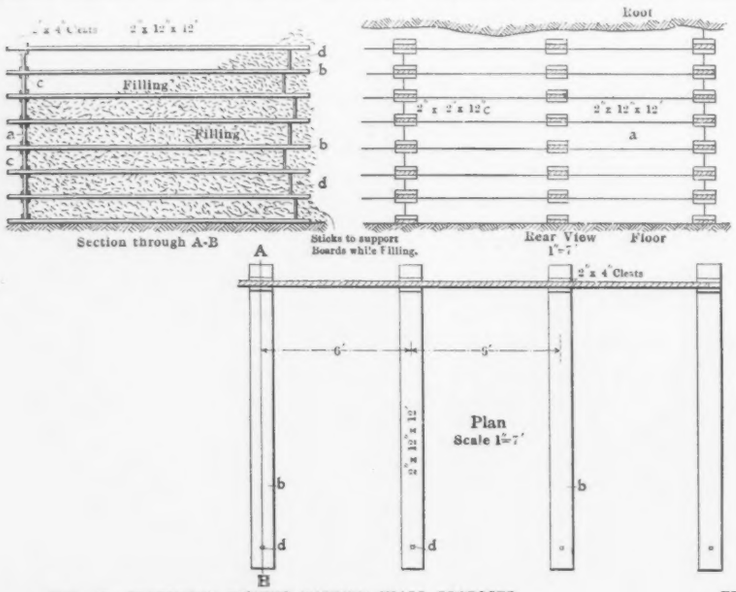

FIG. 7. SECTIONAL TIMBER BARRIER WALL PROPOSED FOR USE WITH FILLING

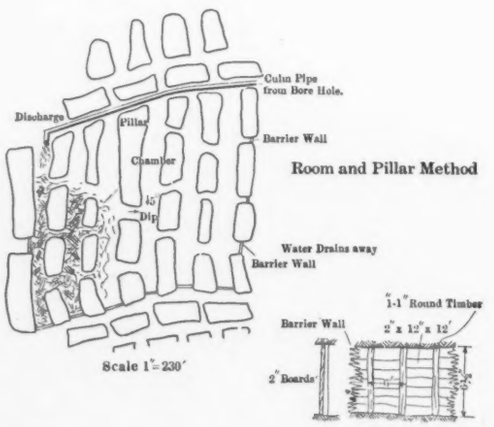

FIG. 8. TYPICAL AREA IN A FLUSHING OPERATION IN PENN.

FIG. 6. BARRIER WALL

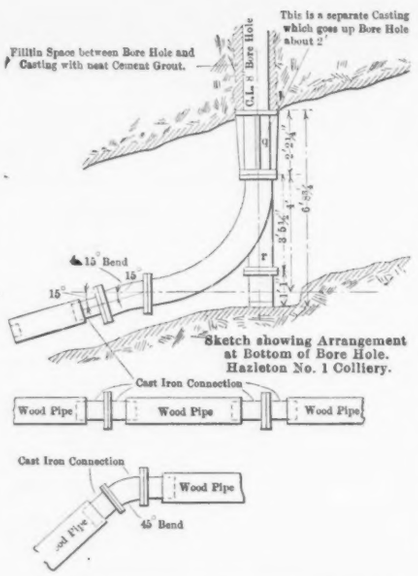
Filling Space between Bore Hole and Casting with neat Cement Grout.
This is a separate Casting which goes up Bore Hole about 2'
C.I. 8" Bore Hole
15° Bend
Sketch showing Arrangement at Bottom of Bore Hole. Hazleton No. 1 Colliery.
Cast Iron Connection
Wood Pipe
Wood Pipe
Wood Pipe
Cast Iron Connection
Wood Pipe
45° Bend

FIG. 9. DETAILS OF PIPE CONNECTIONS

comes in contact with the water which conducts it to the chambers where the filling is going on. The material at this place attains a maximum of 1 in. in size, and it is said that the ratio of liquid to solid is 4:1. It was found here that a mixture of the shale with sand gave better results as regards consistency and its relation to shrinkage.

In the mine at Pas de Calais, as in certain mines of Westphalia, canvas brattices are used underground to hold the filling intact, instead of the timber barrier form previously described and more universally adopted. A light framework is first constructed of timber at the point where it is desired to bank the filling, and the canvas is hung snugly on this framework. The canvas itself acts as a filter, and the water passing through same, proceeds directly to the pumps.

Rescue Work at Hamstead Colliery

By D. J. Pierce*

The rescue operations incident to the Hamstead mine disaster near Birmingham, England, were marked by unusually heroic incidents. The coal at Hamstead lies at considerable depth and the pressure upon the seams has caused frequent trouble through the generation of heat. The last and most disastrous fire occurred in such a position as to entrap 30 men in the workings. The main shaft, nearest the location of the fire, was temporarily out of use owing to the breakdown of an engine, and only a smaller ventilating shaft was available for use. After several unavailing efforts to reach the entombed miners, it was decided to reverse the ventilation of the mine.

Ventilation Was Reversed

As is usual in English mines, the pit where the disaster occurred had two vertical shafts, one down-cast and the other up-cast, the ventilating fan being connected by an air drift to the up-cast shaft and drawing the air into the down-cast shaft through the workings and up the up-cast shaft. In order to draw the air down the up-cast shaft an entirely new fan installation was required since the fan in use could not be moved.

A 60-in. Sirocco turbine fan, delivering 80,000 cu. ft. of air per min. was requisitioned from a neighboring colliery, and hundreds of men set to work to build an air drift from the down-cast shaft to the suction. This air drift was 150 ft. long and 7 ft. in diameter. Thousands of tons of earth had to be excavated for the new air duct, but this, and the building of the brick drift was begun on Friday and finished Sunday afternoon. The bricklayers and laborers worked night and day, with only occasional moments of rest to eat. When the brickwork of the old shaft was reached, it was found to be almost as solid as iron, but the tired laborers attacked it with pick-axes and finally succeeded in connecting up the fan with the down-cast shaft.

An Almost Impossible Feat

To excavate for and build an air drift 50 yd. long and 7 ft. in diameter, install a fan and connect the fan by steam mains from its engine to the boiler house, in a space of two days seems an almost impossible feat, but this was what was actually accomplished. The report of the superintendent on the work says: "Owing to the comparative simplicity and lightness of the fan and the installation work, it was possible to erect it and finish off the duct, shaft, fan, and engine foundation, and have everything in going order in 48 hours from the time the fan and engine were unloaded from the trucks."

When the walls of the down-cast shaft were penetrated, it was found to be filled with dense clouds of smoke, but after the fan had been working a few hours the air was so clear that the rescuers descending the up-cast shaft were followed by the air current instead of being obliged to meet it charged with smoke. Although the rescuers were too late to save the lives of 26 of the men entrapped by the fire, the records made during the efforts at rescue will stand unbroken for a long time, according to the experts whose views are quoted in English journals.

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FIG. 1. INSTALLING 60-IN. SIROCCO FAN AT HAMSTEAD COLLIERY

The cheapest and best coal in Japan for manufacturing iron is in Hokkaido, along the railway line, a short distance north of Muroran, where the supply is abundant.

Coal in the Dominican Republic

The extensive valley lying between the central range, or Gran Cordillera, and the Cordillera Setentrional, or Monte Cristi chain, abounds in coal deposits, those of the Pacificador district being the best known. According to a recent British consular report, the coal of the first mines discovered around Samana bay was of such a character as to lead to a general belief that the coal deposits in the Republic were still in the period of formation, and consequently that it was useless as fuel; this, however, was apparently a mistake, as large quantities of excellent coal, ready to be used as fuel, are to be found. Anthracite coal, stated to be as good as the best grades on the market, has been found in the Tamboril, province of Santiago, in the valley above mentioned. Both lignite and anthracite deposits are found in Altamira, Puerto Plata district, on the spurs of the Monte Cristi chain, and samples of anthracite from San Cristobal in the province of Santo Domingo have been tested with, it is said, excellent results. Other coal deposits have also been found in the Azua province.

In a report from the United States consul-general at Marseille, it is stated that the French bauxite deposits, which were the first to be discovered, continue to be the most important in the world, both in extent and value. The first valuable beds were found in the neighborhood of Les Baux, a few miles to the west of Marseille, which accounts for its name. At present the chief sources of supply are in the department of Var, a few miles east of this city, from which export shipments are made.

Coal Mining Methods in Randolph County, Mo.

Plans for Shaft Sinking and Entry Driving with Especial Reference to the Location and Firing of Holes; Dimensions of Pillars and Rooms

BY J. J. RUTLEDGE

In the present condition of the coal trade in the middle West, any coal seam of less than 4 ft. in thickness, of average quality, and lying under a weak tender roof, presents serious problems in the mining and marketing of the coal. Such a bed is found in Randolph county in northern Missouri and some of the details of the practice in working this deposit by hand and machine may prove of interest to coal men.

As a general rule, one of the greatest problems in working thin seams by the pillar-and-room method is to furnish new working places fast enough to take the place of the older rooms as they are worked up and exhausted. The rooms are usually advanced proportionally faster than the entries are driven, and miners are compelled to wait until additional entry can be provided before they can secure new working places. Part of this trouble is due to the scarcity of good entry-men or the disposition to shoot the coal off the solid instead of cutting the

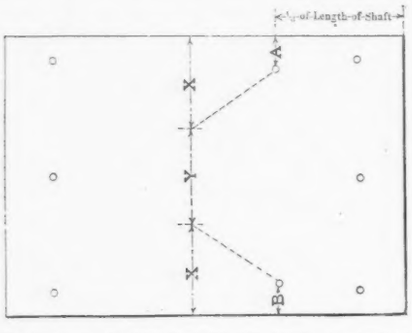

FIG. 1. PLACING SHOTS IN SHAFT BOTTOM

entries; another cause arises from working entries single shift. One mine foreman gave as the results of his experience the rule that, in Kansas and Missouri, every seventh man at work in the coal in a given mine, should be an entry-man, in order to keep a sufficient number of working places open to produce a uniform daily output of coal.

Shaft Sinking

Some methods of mining, by hand and machine, in the northern Missouri coalfield, are illuustrated in the following notes: The coal seam mined varies from 3 to 4 ft. in thickness, is uniformly horizontal, and lies 60 to 170 ft. from the surface. One of the shafts is 174 ft. in depth and the time consumed in sinking it was two months; during one-third of this time there were three shifts employed, and during the remaining two-thirds, two shifts. There were 4 men on every shift, one of whom led the shift, or acted as foreman. The cost, including labor and all supplies, was $18 per ft. Measured in the clear, the shaft was 7½x16 ft. and was timbered with 4x10-in. yellow pine.

All work was done by hand; hand steel, or "jumpers" of 1-in. octagon steel, were used in hard ground, while in soft ground the ordinary coal miner's "churn drill" was employed. As there was considerable shale, the churn drill was used about two-thirds of the time. The ground passed through was composed of hard limestone layers, varying in thickness from 4 to 6 ft. and rather soft dark-colored shales. Some 20 to 30 ft. of drift was encountered near the surface.

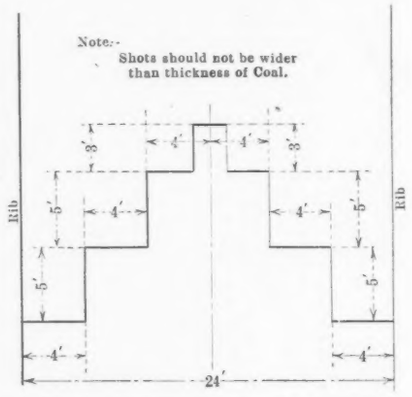

FIG. 2. PLAN SHOWING SHOTS 5 FT. LONG AND ROOM 24 FT. WIDE

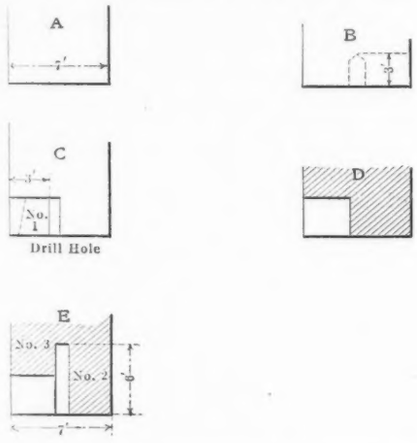

FIG. 3. METHOD OF DRIVING 7-FT. ENTRY BY HAND

Placing Shots in a Shaft Bottom

In beginning to sink the sump, "holes" *A* and *B*, Fig. 1, are started at about ⅓ of the length of the shaft from one end. These holes are drilled at an angle of 45 deg. with the horizontal and are pointed toward the center of the shaft. The holes are 5 ft. in depth and so drilled that the distance *x* is ⅓ of the entire breadth of the shaft.

Two men can usually drill four 4-ft. holes in 8 hours and then fire them. Four sticks of 60 per cent. dynamite are generally used in each hole. These holes being fired give a sump 3 ft. in depth. There are 8 holes in all, 2 sump holes and 6 end holes. The entire 8 are drilled at the same time, and the sump holes are fired first. The end holes are 3 ft. in depth, nearly vertical, and so placed as to trim ends and corners after the sump holes have been fired. The plan is to give a 3-ft. cut at each firing and to complete sinking 3 ft. every 24 hours. When 3 shifts are employed, No. 1 shift drills the 8 holes; No. 2 shoots the holes, and No. 3 does the timbering. The sinkers receive $2.80 per 8 hour shift.

The ordinary jumper drill and 8 lb. hammer are used, double handed. Timber is lined by 4 plumb lines, one in each corner and after all muck has been sent up and the bottom squared up carefully, a set of timbers is placed on the shaft bottom and carefully leveled by a spirit level. Then each set is wedged by driving pine wedges against the outside of the side pieces.

The end pieces are usually forced in place, between the ends of the sides, by jacks, and the joint is a very strong one. A one-half inch notch in the ends of end and side pieces gives a substantial joint and one not pushed out of place.

Solid Shooting

In solid shooting as ordinarily practiced, the miner looks for "chances," that is, he selects those points along the coal face in his room where coal can be "shot off the solid" without any shearing or undermining. As the physical quality of the coal in any given seam is always changing more or less, and slips, in coal and roof are frequent, the miner cannot always gage his powder correctly to meet these changes. Sometimes he uses too small a quantity of powder and the shots "stick" and must be worked off by vigorous use of the pick during the time or the day following when the miner should be loading his coal. At other times he uses too much powder and the coal is blown to

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small pieces and scattered all over the working place, knocking out props and injuring the roof. The next day the miner must spend some time in resetting his props and has no coal to load. For the above reasons, the foreman of the mine in which this method of producing coal is employed cannot with confidence expect a uniform daily output from his mine unless he employs a larger force of men than would be necessary to produce his regular daily output if all his men had coal to load.

Improved Method of Solid Shooting

The plan shown in Fig. 2 illustrates the improved method of solid shooting in a room 24 ft. wide, and in a 12-ft. entry. The room pillars are 6 ft. thick and the room face is shown after the place has been turned. It is only necessary for the miner to cut 1 ft. per day, in the room, in order to have his shots in good shape.

In the 12-ft. entry, the cutting is made 4 ft. from the rib, which gives 3 shots across the width of entry, each 4 ft. wide. After the first shot, 3 ft. long, is fired, a second 3-ft. cutting is then put in by the miner and the second shot, which is 4 ft. wide and 6 ft. long is set off. Following this, the miner puts in another 3-ft. cut and a third hole is fired. The entry advances 3 ft. per day when in the hands of a good miner. It is said that this plan yields 20 per cent. more lump than the common method of shooting coal off the solid indiscriminately and without any freeing of the shots by cutting. Each shot, 6 ft. long, 4 ft. wide and 4 ft. high yields about 2¼ short tons of coal. By this plan the room man often averages 4½ to 5 tons per shift, while 3 tons is the average where no cutting is done. The entry man averages 3 as against 2 tons by the ordinary plan. This is by "miners weight."

Method of Driving a 7-ft. Entry by Hand-mining

The coal varies in thickness from 3½ to 4 ft. The entry is 7 ft. wide and at the commencement of work, has a square face as shown in Fig. 3 (*a*). A cutting 3 ft. deep, about 1 ft. wide and the thickness of the coal in hight is then put in by means of the miners' pick. When this cutting is completed a drill hole is put in and the shot marked No. 1 in Fig. 3 (*c*) is fired. This leaves the face of the entry as shown in Fig. 3 (*d*); another 3-ft. cutting is now put in, as shown in Fig. 3 (*e*). After this work has been performed, the miner has a shot 6 ft. long, and about 3 ft. wide, as shown marked No. 2 in Fig. 3 (*e*). After this No. 2 shot has been fired, an additional 3-ft. cutting is put in and a 6-ft. shot is made at No. 3 in Fig. 3 (*e*). When the work is properly performed and discretion is exercised in the amount of powder used to shoot the shots, the entries furnish good coal, the tender roof is not unduly shattered, and an advance of 3 ft. per day is made.

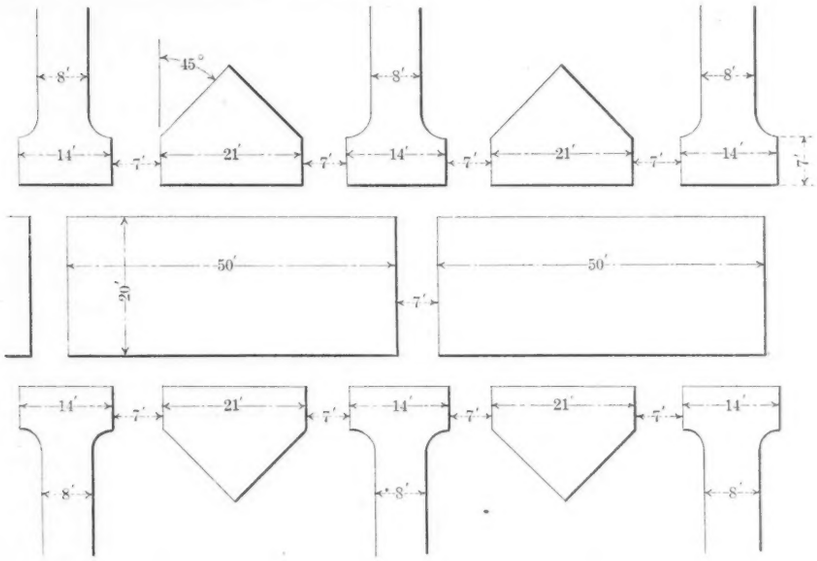

FIG. 4. ROOMS IN MACHINE MINE

In following this plan, many thin seams of coal will be more advantageously worked by vertical shearing either by hand or machine, combined with solid shooting carefully done, than by undercutting in coal or clay. This is more especially true of seams having a rather thick dirt band in the lower part of the seam, at which band the coal parts after being undermined, allowing the lower coal to fall, causing trouble in blasting the coal down. The undermining, when done in the clay, as it is often carried on, generally causes trouble in loading dirty coal.

Rooms in Machine Mines

The coal mined by machines is on an average about 3 ft. 9 in. thick. Main entries are driven 9 and 12 ft. wide, as the roof is of a gray shale and very tender. Cross-entries are turned at distances of 240 ft., and are driven 7 and 12 ft. in width. Close timbering is necessary on main and cross-entries. The rooms are turned, as shown in Fig. 4, with room pillars 8 ft. in thickness and a triangular stump pillar 21 ft. wide and carried back to the distance of 21 ft. from the entry to a point, the widening being on an angle of 45 deg. with the center line of the roadway. Each room pillar where it is fronted on the entry, is 14 ft. in width, and all room necks are 7 ft. wide and 7 ft. deep. As the coal is thin for machine mining, the self-propelling Sullivan machine electrically operated, was employed. This machine weighs about 3000 lb., and runs from right to left across the face of the room. The practice is to run the machine in the room to the room face by means of the right-hand road, then it is unloaded and run across the room face to the head of the left-hand room road, cutting a 6-ft. undercut in the clay. The cutting space is 4 to 5 in. deep, and generally all in the clay under the coal. Rooms are usually turned by a machine, running the two-room necks together on the left to make the room face, as the room is opened up. By giving 2½ ft. on the rib side of each room road, a room 40 ft. in width is made. This gives an economical working face for the self-propelling heavy mining machines and permits of their being brought to and

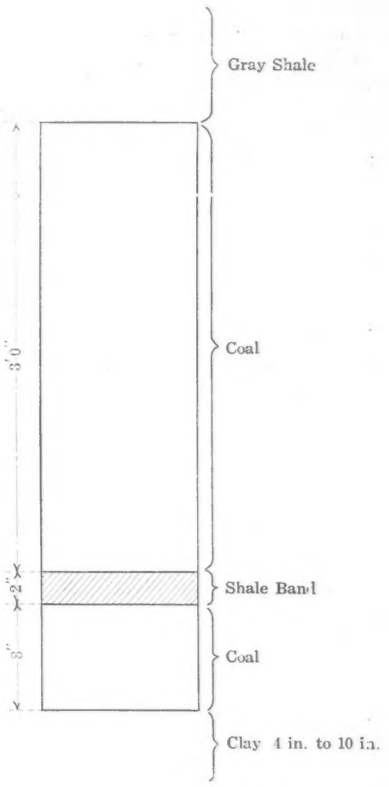

FIG. 5. SECTION OF MACHINE MINED COAL IN RANDOLPH COUNTY, MISSOURI

from the working faces expeditiously.

Some 40-ft. rooms are undercut in 45 min., but usually the time required to undercut a room face is about one hour. The cutter bar is 6 ft. long and 18 in. wide. Entry pillars are about 50 ft. long and 20 ft. thick, with 7-ft. crosscuts.

Owing to the difficulties in handling the clay from the undercutting and the necessity of waiting for places, the average per shift is only about three 40-ft. rooms, or 120 ft. of lineal undercutting. As a rule, two men could load out the coal in a 4-ft. room in 1½ shifts. From each room cutting about 38 tons of coal, miner's weight, was loaded out, the two tons probably going to the bands and impurities in the coal. An average daily output per man in the rooms is 5½ tons in entries, and five tons to each cut.

It is thought advisable to have all the pillars of 20-ft. width instead of one being 21 and the other 14 ft. The room pillar should be 10 ft. instead of 8 ft. thick, and room necks should be 12 ft. deep and 7 ft. wide, instead of being only 7 ft. deep as at present. The Sullivan machine used, required a distance of 6 ft. between the face of the coal and the last row of props. In one mine the room roads were 5 ft. from the rib with one row of props between. There were on an average, in this mine, three 4½-ft. props used to each ton of coal produced. The clay under the coal varies in thickness from 6 to 10 in. Under the clay is a hard limestone and in best practice, the props are footed on this limestone.

Goodman electric mining machines are also used. These undercut to a depth of 6 ft. and are used to cut the entries, and generally work on the night shift. Goodman haulage motors are used and one Morgan-Gardner haulage motor.

New Rescue Apparatus for Mines

The Institution of Mining Engineers, which has its headquarters at Newcastle-on-Tyne, England, its members being chiefly men connected with coal and iron mining, held its annual general meeting in London during the first week in June. The mornings were devoted to the reading and discussion of papers, while the afternoons were spent in visiting works and the mining and metallurgical exhibits of the Franco-British exhibition now being held in London. Among the works visited were those of Siebe, Gorman & Company, who construct diving apparatus for the British navy, and who in recent years have given special attention to the manufacture of apparatus for rescue work in mines. Appliances are made for use under water as well as in poisonous atmospheres. The apparatus for both purposes is of a simple, reliable and inexpensive nature, and considering their great value as a means of saving life, they ought to be found in every mine that is liable to an explosion or to being flooded.

The demonstration given at Siebe & Gorman's works included four separate exhibits. The ordinary diving dress, as used for marine work, was first shown. The diver is here supplied with air from an air pump at the surface and is in communication with the surface through a telephone. The second exhibit was a self-contained diving apparatus, in which a supply of oxygen is carried by the diver in steel cylinders. This apparatus is more likely to be of use in mines than the ordinary diving dress, because the diver can move about more freely. This self-contained apparatus is the invention of Mr. Fleuss, who proved its successful application when, a quarter of a century ago, he saved the workings of the Severn tunnel, when they were accidentally flooded by an irruption of water. A feature of the apparatus is that the supply of oxygen is automatic. Pure oxygen is not, however, supplied to the diver, but a mixture of 40 per cent. of pure oxygen and 60 per cent. of air. By this means the danger of oxygen-poisoning at ordinary depths is avoided. Of course, much more of this mixture is needed than if pure oxygen were supplied, but the extra weight of steel cylinders is of little importance, as the diver must be artificially weighted in any case, to enable him to sink. The most recent form of the Fleuss apparatus was publicly shown for the first time, a diver giving a practical demonstration in a large tank.

While this apparatus may, no doubt, be usefully employed at a mine for getting at drowned-out pumps, or closing water-tight doors, and similar work, it does not compare in value with the appliances made for enabling men to descend into mines filled with smoke or poisonous gases. Here human life is usually at stake and with this apparatus available, the lives of many men entombed by falls of ground may be saved. The dress is somewhat similar to that used under water, but is lighter. The Hall-Rees light diving dress and smoke helmet, designed by two naval officers, was designed more particularly for rescuing men from a submerged submarine, but it can also be used as a smoke helmet. It is very light and can be put on without assistance in 30 seconds. The oxalate, or air purifier, is carried in a case fixed to the front of the man's jacket, and the vitiated air passing through the oxalate is re-oxygenated and used over and over again. It is made for a service of two hours.

The improved Fleuss apparatus was also shown and a demonstration given of its use in an experimental gallery filled with poisonous gases. In this apparatus the oxygen supply is carried in a cylinder, or in two cylinders, on the man's back and there is a breathing bag in front. Attached to the bag is a pressure gage enabling the man to see exactly what quantity of oxygen remains in his cylinders and warning him when to return. The dress is light and allows free movement of the body, and a man equipped with the apparatus can crawl through a small opening without any danger of the apparatus being damaged, the bulkier part of the apparatus being fixed in the small of the back, so that if a man can get his head and shoulders through an opening, he knows this his oxygen cylinders will go through safely.

Those who are interested in this subject will find much detailed information in the *Transactions* of the Institution of Mining Engineers, as well as in the report of the Royal Commission on Mines. The subject is of the highest importance and all managers, who have human lives dependent on them, ought to inform themselves of the work that has been done in connection with rescue appliances for mines. Science has given the miner a weapon which enables him to defy water, smoke and firedamp, and there can be no excuse for failing to provide the appliances which may save life, or at all events mitigate the horrors of a mine disaster.

A California Power Plant

SPECIAL CORRESPONDENCE

The Great Western Power Company has commenced work on its extensive dam at the intake of the Big Bend tunnel in Butte county, Cal. Electric cars run through the tunnel from the power plant at the lower end to the dam at the upper, conveying material. The tunnel is 3 miles long and 18 ft. high in the clear, lined with cement. This same company has commenced work also on its transformation sub-station in East Oakland. This is at Sessions basin on the edge of the deep water in Oakland harbor. On this same property will be erected a steam-power plant to develop 25,000 h.p. by the use of fuel oil, as an auxiliary. The transmission lines are now in course of construction, and between 30 and 40 miles of them have been finished. Stretches have been completed above Oroville, in Sacramento county. The transmission cables are carried on steel towers 30 ft. in hight, and it is expected that the first installation will have been completed by October. At this time the delivery of 65,000 h.p. of electrical energy will begin. The transmission line, when completed, will pass through Butte, Sutter, Sacramento, Yolo, Contra Costa and Alameda counties, crossing the San Joaquin river at Antioch. It is generally understood that much of the power generated at the Big Bend electric plant will eventually be used on the lines of the Western Pacific Railroad.

Coal Dust as a Factor in Mine Explosions

Liability of Coal Dust to Explosion Increases Almost Directly with Its Percentage of Volatile Combustible Matter. Size Also of Importance

BY HENRY M. PAYNE*

Shortly after the completion of my investigation of the Monongah explosion, your president asked me to address you at this meeting, and as the intervening time seemed ample for preparation, I consented. I almost immediately began a series of foreign correspondence for the purpose of securing all possible reports and data which would enable me to present to you at this time, a resumé of the coal-dust problem in its highest development, but I had no conception of the mass of material which must be assimilated, or of the labor entailed in its compilation.

For any apparent omissions or incomplete developments I do not plead procrastination, but rather the fact that the preparation of the material embodied, required the translation of over 80 books and reports in French and German, and over 1000 letters and magazine articles in these and other languages, a complete or even comprehensive summary of which would assume the dimensions of a book of considerable magnitude.

Coal dust is first mentioned as a dangerous element in 1803, next in 1828, and again in 1844 and 1845. All these cases were in England. In 1855, 1861, 1864, 1867, and 1875 we find records of experiments in France. Since that time, France, England, Germany, Prussia, Belgium, and the United States have all shown periods of active investigation, culminating in recent years in coal-dust commissions, bureaus or departments of mining, and the establishment of stations for technological research.

Upon certain basic principles, all scientists seem agreed. Coal dust has existed in coal mines from the earliest dates, and and is a more or less unavoidable product. The quantity produced in our modern mines is comparably large, compared that produced in the earlier days, and consequently the dangers of coal mining are correspondingly increased. This increase is due principally to the large output of the present day, the greater depths reached, the more common use of explosives, extended haulage systems, large number of men employed, and high speeds used in transit. The amount of coal dust produced depends mainly on the nature of the coal. A coal easily friable may be so mined as to avoid much of the dust, by care and skill in mining, and attention to the condition of roadway and rolling stock.

Thus far, we find unanimity of opinion, but at this stage, investigators become distinctly segregated into two classes. The first of these maintain that a dust explosion is only possible in the presence of firedamp, while the latter assert that under certain conditions of fineness, suspension and temperature, any organic dust is explosive. In considering either of these classes we find striking illustrations, records, and experiments tending to support the claims of its adherents.

It appears to me that in weighing such arguments, the first point of differentiation is to establish a line of demarcation between combustion and explosion. All combustible material may be considered as explosive if the conditions under which combustion takes place, are such that disruption and consequent expansion, or decomposition, occur so nearly simultaneously, that the expansive force is manifested before the heat generated by the transfer of energy into kinetic form can be appreciably recognized. The one element upon which such manifestation depends more largely than any other, is room for expansion. Hence the danger from any accumulation of dust increases rapidly with the distance in from the mouth of the mine, and it is probable that what have been described as dust explosions in coal tipples might more correctly be classified as combustions.

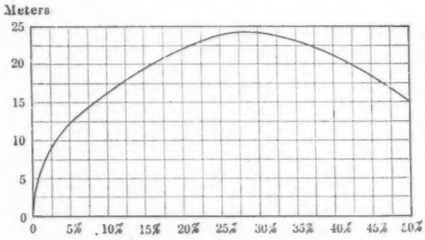

FIG. 1. RESULTS OF GELSENKIRCHEN EXPERIMENTS

An illustration of this class of phenomena is had in the case of La Belle works several years ago, where a crusher was being installed. The coal is hard, and at least 20 per cent. of the crusher product will pass a No. 100 screen. The crusher was located in a pit and was housed up perfectly tight, the only opening being that for belt connection with the motor. At the point where the belt came through the wall, several thicknesses of common canvas had been placed, and there was an accumulation of several inches of dust over surrounding timbers and canvas. The canvas was ignited by a hot bearing on the motor, and began to burn slowly. The attendant attempted to beat out the blaze with another piece of canvas which immediately threw large quantities of dust in suspension, over the blaze, which then shot up the chute 15 or 20 ft. As soon as the dust around the blaze had burned up, however, the fire went out altogether.

Next in importance to room for expansion is the degree of inflammability of the dust, the density of its suspension, and its fineness, or state of divisibility. Probably the most exhaustive series of tests yet made to determine the elements entering into, and controlling the inflammability of various dusts, are those made at the Gelsenkirchen station (as reported in various issues of the *Glueckauf*, and in the publications of that station) and those under the supervision of M. Taffanel at the Lievin station, and published as a report of the central committee of coal mines of France.

The results of the Gelsenkirchen experiments are shown in Fig. 1. Increasing rapidly as the percentage of volatile matter is augmented, the point of inflammability reaches the highest point on the curve at about 29 per cent. volatile, after which it drops off almost as uniformly as it rose until it passes beyond 50 per cent., farther than which we find no record.

The experiments of M. Taffanel, of the Lievin station are described in detail, and one cannot fail to be impressed with the extreme care and accuracy with which they were performed. In all cases dust, which would pass through a No. 200 screen of the finest bolting cloth, was used, and a uniform charge of one-half cartridge of dynamite gelatine weighing from 32 to 38g. was placed without ramming, in a cannon, made by boring a hole about 1½ in. in diameter and 6 in. deep in the end of an old steel engine axle, which was placed on a truck at the end of the explosion cylinders.

A ventilation system being produced by either compressed air or a motor-driven fan, the air and its load of dust circulated in a closed circuit, through the main cylinder and its return, corresponding precisely to a section of a main mine entry and its accompanying airway and intermediate break-throughs. Preliminary tests having shown that high velocity of the air-current is unfavorable to ignition, a uniform velocity of 4 to 5m. per second was

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NOTE—A paper read before the Coal Mining Institute of America, Greensburg, Penn., June 8, 1908.

*Professor of mining engineering, West Virginia University, Morgantown, West Virginia.

adopted for all the experiments, and all the samples tested were exploded both with and against the air-current, ignition being always greater when the shot was opposed to the direction of the air, or relatively toward the intake.

The density of the cloud is regulated by the amount of dust fed into the cylinders from the hopper. The lading process continues from 15 to 150 sec., depending on the density required. During this period the dust-laden air travels around the closed circuit from 5 to 50 times, the eddy thus created securing perfect homogeneity of the cloud.

The lowest density at which ignition was invariably produced, was 70g. of dust per cubic meter, and below a density of 46g. per cubic meter nothing but negative results could be obtained.

M. Taffanel draws the following conclusions with regard to the influences of the density of the cloud:

"There is one certain density for which the total combustion of the carbon and of the volatile matter, with exclusive formation of carbonic acid and watery vapor, should absorb exactly all the oxygen of the air; such a density would be particularly favorable to the propogation of flame * * * . Having noted the low percentage of ash and the high percentage of volatile matter, this density ought to lie below 111g. per cubic meter. But, when the density is raised above this value, the tests do not show any sign of stifling the flame through want of oxygen; on the contrary, the greater the density the greater the flame. Yet, we should not deduce from this that stifling the flame or arresting its propagation by excess of dust, is never produced * * * . The violent pressure of the gas, which promotes combustion in the tube, forces beyond this into the midst of the burning gas, the dust incompletely burned; this combustion is completed at the expense of oxygen taken from the atmosphere, producing at the extremity of the tube, a flame whose extent is proportioned to the weight of unconsumed dust projected.

"After the ignition of very dense clouds of dust, and especially when the density exceeds 250g. per cubic meter, there are found in the tube, deposits of unconsumed dust with indications of partial distillation. These are agglomerated in frothy fragments, * * * and have the appearance of coke crusts such as may be found on mine timbers after a dust explosion."

Many of these crusts were gathered after ignition and analyzed. The percentage of volatile combustible matter had decreased from 29.7 per cent. to 25.1 per cent. while the ash increased from 5.5 per cent. to 10.5 per cent. This increase in ash testifies to the partial combustion.

The result of all these tests leads us to believe that large quantities of dust are not necessary, when homogeneously suspended, to form a dangerously inflammable cloud, since these last experiments show us invariable ignition at a dust density of 70g. per cubic meter, while as a matter of fact it is not unusual to find a density of 100g. per cubic meter in any mine passage of an old mine, under high air-current velocities, leakage of compressed-air pipes, or extremely rapid haulage. Reference to Fig. 2 shows entirely different results as determined by M. Taffanel, from those shown in Fig. 1.

The Lievin tests failed to get an ignition with any of the dusts until passing 11 per cent. volatile matter by analysis, after which the point of ignition lowered rapidly as the percentage of volatile matter increased, and after reaching 17 per cent. the curve becomes almost a straight line, passing off at about 29 degrees, and very regular, up to 53 per cent. volatile matter, beyond which the experiments were not carried.

The reason for such a marked difference between Figs. 1 and 2 can only be conjectured. I am inclined to the opinion that the extreme uniformity of experimental conditions which governed the French investigation, such as uniform weight of explosive, uniform air-current and temperature, had much to do with

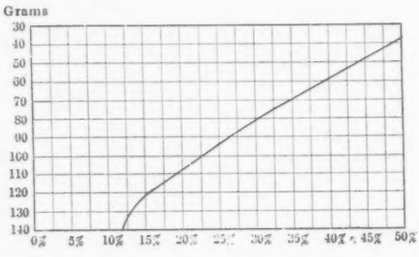

FIG. 2. TESTS AT LIEVIN

bringing about the regularity of results, and I believe that the extreme fineness of the dust used had a pertinent bearing on the value of these results, to which latter feature I shall revert subsequently.

Professor Abel states that the proportion of firedamp required in a mine to bring dust into operation as a ready explosive material, is below the smallest amount which can be detected by the most experienced observer. The Prussian Firedamp Commission in 1885, concluded that a minute quantity of dust in the presence of an almost indistinguishable amount of firedamp would produce violent explosions, so that a dust not otherwise dangerous, may give rise to a disastrous explosion under these conditions.

Foster and Haldane state that while the possibility of a purely dust explosion is bound up with the presence of certain kinds of coal, and while on the other hand a comparatively high percentage of methane is necessary in order to form an explosive mixture with air, such as in most mines must be regarded as an exception, coal dust and methane coöperate; and it is, therefore, possible for explosive conditions to arise in almost any mine, since there is everywhere opportunity for the formation of coal dust.

In 1886 a Commission for the Investigation of English Mine Accidents, reported among other conclusions: "The occurrence of a blown-out shot where but a small percentage of firedamp exists in the air, in the presence of but slightly inflammable, or a wholly non-inflammable but very fine, dry, and porous dust, may cause an explosion, the flame of which may reach other distant accumulations of gas or deposits of inflammable dust." Henry Kinlock in an article in the *Colliery Engineer*, Vol. 9, p. 26, says that if dust were the principal agency in coal-mine explosions, every blown-out shot would be attended by a disastrous explosion.

We now come to the consideration of those investigators whose experiments and observations lead them to the conclusion that any organic dust is explosive under stated conditions: Richard K. Meade, editor of the *Chemical Engineer*, describes in detail the explosion which occurred at the Edison Portland Cement Company's plant some three or four years ago. At this plant, the coal was crushed between rollers, and the pulverized product blown out into settling chambers, the coarse product being returned for regrinding. A small fire started in an elevator leading from a drier used to dry the coal, and passed over into the settling chamber, in which there was at all times an atmosphere heavily charged with fine coal dust. The explosion which occurred wrecked the building, blowing off the steel sheets riveted to the steel framework.

Professor Peckham, of the University of Minnesota, describes in the March, April and May, 1908, issues of the same journal, the dust explosion in the Washburn Flouring Mills at Minneapolis, in 1878, and shows conclusively that sparks of fire generated between the millstones, ignited the flour dust in the conveyers and dust room, causing both to explode. To support this conclusion, he observes at length, that there were no explosive materials of any kind in or about the mill; that no electric phenomena had ever been observed in connection with the mill; that while dust may be made so fine as to float in air, and water may float in air as a fog, yet neither is a gas, and flour dust is not a gas.

He then states the chemical analysis of wheat flour, and shows the various temperatures and conditions under which it emerges from the stones, and relates that if wheat flour were subjected to destructive distillation, hydrogen and carbureted hydrogen (methane) would be among the products of decomposition, and concludes that wheat-flour dust, when fine, dry, and hot enough, will explode.

To corroborate his position, he quotes the explosion in the soap works of the Kendall Manufacturing Company, at Providence, R. I., in 1890, after which he carried on a series of experiments with various kinds of flour, powdered sugar, planing-mill dust, powdered soap, powdered

asphaltum, and similar substances, every one of which will explode when extremely fine, properly suspended in a homogeneous cloud, and mixed with the requisite amount of air. In fact powdered soap, in contact with an open gas jet, gave evidence of a greater explosive force and more intense heat than could be produced from any of the other dusts named. (Within the last month our attention has been directed to an explosion of pulverized sugar in a sugar refinery in Paris, wherein 42 lives were lost and property worth $100,000 destroyed.)

Professor Peckham's work extended over so many years, and was so thorough, that I cannot do better than quote his own words in reference to recent coal-mine disasters in West Virginia and Pennsylvania: "It is not necessary to assume the presence of firedamp at all. Coal dust and air in proper proportions, ignited from a blast, are an ample and wholly adequate cause for all the phenomena that occurred. Years of immunity are no safeguard against a critical condition that may appear at any moment, and yet never come. * * * In a mine explosion, no one observes either cause or effect from the outside. The few who survive are usually remote from the initial steps in the phenomenon. * * * It is, therefore, only by analogy that it can be reasonably assumed that a slight accident or indiscretion, by which the initial explosion of a mixture of coal dust and air jars the dust into the air from an adjoining chamber, from which a succession of explosions follow * * * until the cumulative effect is irresistible and almost irretrievable disaster. * * * Immaculate cleanliness and eternal vigilance are the price of safety in all * * * mines where oxidizable dust is produced."

Henry Hall, in 1876 and again in 1890, stated that his experiments for the Royal Coal Dust Commission had not shown that gas is necessary before an explosion of dust can occur, but that coal dust from some seams is as sensitive to explosion as gunpowder itself, its sensitiveness being in direct proportion to its freedom from impurities. Doctor Foster, late Professor of Mining Engineering at the Royal School of Mines, London, says that it has been proved that the dust of certain coals, especially the bituminous coals rich in gas, may be the cause of explosions, when methane is completely absent.

Prof. T. H. Cockin, in his latest book on "Coal Mining," says: "That coal dust and air can cause all the effect of a violent explosion without the presence of gas is proved by the following:

"First, a violent explosion can readily be caused by the experimental firing of coal dust and air.

"Second, explosions of coal dust and air have taken place on screens, etc., on the surface. (NOTE.—These latter are more properly designated as combustions.—H. M. P.)

"Third, violent explosions have taken place at collieries in which no gas has ever been detected, either before or after the explosion.

"Fourth, many recent explosions have originated in the main intakes, in which dust in its most dangerous form was most likely to be found, and in which it was impossible for large volumes of gas to have been present. The quantity of such dust in the air, necessary to give rise to an explosion depends upon various circumstances, but the dust must be intimately mixed with the air in the shape of a cloud, though the cloud need not necessarily be very dense."

Professor Abel (above referred to), chemist of the English War Department, writes: "A particular dust, though it may contain but a small proportion of combustible matter, may explode in a very mild or feeble character in the first instance, and be instantaneously increased in magnitude and violence by coal dust raised and brought into action by the first ignition."

As long ago as May, 1878, an editorial in the *Scientific American Supplement* said: "Indeed it would appear that coal dust itself, when mixed with certain proportions of air, renders the air explosive without the presence of any of the gases usually evolved in coal mines."

The most widely read, most frequently quoted and most distinctive conclusions ever placed on record, are those of the Royal Commission of England. Time and space forbid an extended excerpt, but it is interesting to note two of their specific deductions, viz.: "Coal dust alone, without the presence of any other gas at all, may cause a dangerous explosion if ignited by a blown-out shot or other violent inflammation. * * * Different dusts are inflammable and consequently dangerous in varying degrees; but it cannot be said with absolute certainty, that any dust is entirely free from risk."

In *Mines and Minerals*, June, 1898, we find the report of State Mine Inspector Griffiths, of Colorado, on the Crested Butte explosion, in which he deduces, among other conclusions, the following:

"1. That coal dust under certain conditions is explosive in the absence of methane.

"2. That a very little compression of the inflammable ingredients will bring them to an explosive point.

"3. That the dust particles give off their explosive constituents at a lower temperature than is generally admitted.

"4. That an explosion of coal dust can take place without the intervention of shot firing."

Sufficient reference has been made to various authorities to show the sincerity with which the exponents of either theory may attempt to justify their stand, and it is of interest to pass on to the much mooted question of the influence of temperature and barometric pressure upon the frequency or added liability to the occurrence of such explosions. It has been commonly claimed that severe mine explosions are more frequent in cold than in warm weather because of the fact that the air entering the mine is very low in hygroscopic moisture and that on expanding in the mine atmosphere it takes up all the moisture, making the mine dry and dusty; from which argument we immediately develop the statement that the better the system of ventilation, the dryer the mine, and consequently the more explosive the dust.

James Ashworth, of England, in a series of articles published in 1903 and 1904, claims that the presence of moisture in the atmosphere is a marked aid to an explosion, and quotes instances where explosions have followed the wet portions of mines, and shunned the dry places. In summing up his paper on "Air Percussion and Time in Colliery Explosions," he states that the extension of an explosion is probably facilitated rather than retarded by watering and spraying.

The most available data on barometric influence upon mine explosions was published in *Coal*, January, 1908. The statistics upon which the article is based were prepared by D. E. Llewellyn, and show graphically that of all the mine explosions of which records were available between the years 1808 to 1894, in England and Wales, the month of June exceeded any other period of the year, in its disasters. Out of all these explosions, he takes the years 1856 to 1894 and shows that of the 17 explosions in that period, each of which involved more than 100 lives, none occurred in January, March, April, or May, and the months of June and July held equal place in percentage of explosions during those years.

J. T. Beard, in his recent work on "Mine Gases and Explosions," admirably sums up the relation between mine explosions and barometric changes as follows: "The attempt to show that the colder seasons of the year are more productive of mine explosions, has proved almost as futile as the endeavor to show a connection between such explosions and barometric changes. * * * The effect of a sudden fall of barometric pressure * * * is quite generally conceded to be followed, or it may be accompanied, by an outflow of gas from all standing areas and abandoned places in mines. * * * Some assert that there is an increased transpiration of gas from the solid face of the coal due to the decreased atmospheric pressure, but the rate of transpiration is not appreciably affected by any possible fall of the barometer, since the pressures under which gases are occluded, * * * are too great, as compared with atmospheric pressure, to be affected appreciably by such changes."

During the past year there have been many discussions, commercial, sociological, and a few scientific, on the relative

amounts of dust made by different methods of mining, and on the merits of air and electricity from the standpoint of safety. I shall only refer, at this time, to the recently published tests made by the Fairmont Coal Company, and the Westmoreland Coal Company, as relating to the results obtained from various mining machines, which tests may be found in late numbers of *Mines and Minerals,* and to recent articles on the effect of electric currents on coal dust, published in the ENGINEERING AND MINING JOURNAL, from which latter articles we learn that it was only by the use of extremely small wires offering high resistance that temperatures were obtained which would produce explosions under the most favorable circumstances.

The experiments of Prof. B. H. Hite, chief chemist of the West Virginia Geological Survey, have shown that ignition of coal dust by ordinary electric discharge, is impracticable. The results of his present experiments to determine the "flashing point" of coal dust, i.e., the temperature at which finely powdered coal begins to give off a combustible gas, are awaited with interest, since they are being made upon hundreds of samples of coal, from every open mine in the State.

Before discussing the evolution of a coal-dust explosion, I desire to call your attention to some investigations I have been making at Morgantown, with a view to determining the degree of fineness which differentiates dust from slack. We note when reading any modern authority upon coal dust, that the finer the dust, the greater the explosion it will cause, and the lower the point of ignition.

Professor Abel says that the intensity of coal-dust ignition is largely influenced by the fineness of the dust. Mr. Kinlock, in an article in the *Colliery Engineer,* discussing the comparative rapidities of combustion and explosion, states that the rapidity depends principally on the fineness of the dust particles.

Especially relevant at this time is an editorial from *Mines and Minerals,* of July, 1899, from which I quote briefly as follows: "Contents of dust particles are proportional to the velocity of the air movement that suspends them. The minutest particles are the only ones that are suspended in air which has * * * only an eddy motion, as in a closed room where minute dust particles are seen dancing in the sunbeams. The gradation of dust particles with relation to the air movement by which they are suspended is especially important with regard to the inflammability of coal dust when suspended in the air of mines. * * * Large particles of coal burn slowly, as the oxygen required for their combustion can only be supplied by converging streams of air that lie in the radii of spheres whose contents are proportional to the contents of the coal particles; this means that a given sphere of air contains the weight of oxygen required for the perfect combustion of the coal. * * * Large particles of dust cannot produce an explosion because the period required for its complete combustion is too long. Very fine dust such as is suspended in nearly still air, may, however, cause an explosion because * * * the areas of the surfaces of small particles are much larger in proportion to their contents than those of large particles; * * * and because the combustion of the volatile matter disengaged by small particles (which is proportional to their surfaces divided by their contents) requires shorter periods than does the volatile matter disengaged by large particles, because the air and the gas are more intimately mixed, when ignition occurs."

From this it is evident that the only dust that can be consumed rapidly enough to raise the surrounding air to the temperature of flame, is the fine small dust found in nearly still air. Beard, Hall, Cockin, and other authorities unite in saying that fine dust is more dangerous than coarse. Sir William Galloway says that the size of the dust particles is of great importance.

With this irrefutable preponderance of testimony in mind, I began a series of experiments, with various sizes of dust, and velocities of air-current, upon as many different samples of coal as might be readily obtained, and in every instance I found a decided change in conditions between the dust which passes through a No. 80 screen, and that which passes through one of 100 meshes to the inch. The coarser dust acts like fine sand, or granulated sugar, rolling along easily, but held in suspension with difficulty. The finer screenings, however, act more like gaseous bodies, and remain suspended in the slightest circulation. It is evident, therefore, that between these two sizes, there is a sharp demarkation of more than a physical nature, and evidently bordering on or entering into a chemical transition.

We know that divided carbon, in the form of charcoals, has the power to absorb or occlude gases, and the testimony of W. E. Garforth before the Royal Dust Commission of England showed that fine coal dust consisted of hollow spores which acted as reservoirs from which gas is being continuously dissipated in the air, and that each particle of dust is floating in its own balloon of gas.

Organic dust has an affinity for the oxygen of the air, and when brought into contact with the atmosphere, rapidly disintegrates under the combined influence of oxygen and atmospheric moisture. Doctor Bedson, of England, found that the hydrocarbon gases occluded in coal dust are not merely marsh gas, but hydrocarbons containing a large proportion of carbon, and they, therefore, form an explosive mixture requiring a larger volume of air than the marsh gas that comes off before the heavier hydrocarbons. These hydrocarbons are replaced principally by oxygen, and such dust ignites more easily than dust entirely devoid of air. Doctor Bedson's experiments, and those of Professor Hite referred to above, have shown that finely divided coal dust gives off gas at much lower temperature than has been suspected; in fact occlusion takes place at normal atmospheric temperatures much below those at which the usual analyses are made. Where we find instances of partially consumed dust, it is probable that the more volatile hydrocarbons have exhausted all the oxygen, and none is left for the closer burning carbon.

Another reason why the finer dust is susceptible of ignition, lies in the fact, as deduced by James Ashworth from the works of Doctor Bedson, that the lighter gases such as marsh gas and hydrogen are most readily removed, and the coal dust when extremely fine, allows the ready diffusion of the lighter gases into the air, while the denser gases remain for a time. These denser hydrocarbons are in time diffused and replaced by oxygen, and thus we have not only the fine dust lightly floating along in the ventilating current, but also the diffused hydrocarbons which are gradually collecting throughout the mine, or else being mixed with the dust in circulation, lurking in constant readiness for an initial force to give them combustible temperature.

I believe, therefore, that we are justified in stating that any pulverized coal coarser than that which will pass a No. 100 screen is properly classified as slack, liable only to explosion in the secondary sense, as when distilled by the heat or compression of a primary ignition; and that all sizes from No. 100 screenings and finer, may be appropriately designated as dust. This real dust is described by Doctor Mellor as being in a state of "chemical tension," i.e., bordering on dissolution or decomposition.

The effect of compression on such a dust cloud would be very different than that upon gas and air alone, for in the latter case no amount of compression would change the relative mixture of air and gas, while in the former case, it would increase the density of the cloud, which if ignited would create a greater amount of heat and gas in the same space. (Vide *Mines and Minerals,* December, 1907.)

One of the noteworthy features of a dust explosion is the fact that coke crusts are found wherever the coal dust is free from external impurities, but wherever clays or other dust from roof or floor become mixed with it, as along main haulways, these deposits are rare.

We have now in an individual sense, briefly; in a collective sense, at considerable length; but in neither sense, exhaustively, reviewed the various phases of coal-dust investigation. Doubtless we are now more fully cognizant than ever before, of the explosive potential of coal dust, but the problem still confronting us

is how to master the evil genie, the confines of whose territory have so recently been established.

Striving toward this end, we find attention divided between three methods of elimination:

1. Removing the dust.
2. Watering the dust.
3. Using flameless powder.

All that needs to be said of the first is that good judgment and sound mining practice require that all available dust shall be loaded out of the rooms at frequent and stated periods.

Regarding the second, we are confronted with a variety of methods, experiences and opinions. Mel Butler, now superintendent of the Bix Six Coal Company, at Palmer, Washington, whose experience covers the Crested Butte explosion, and an extended service in charge of the Tercio mines in Las Animas county, Colo., writes me at length of his experiments with various methods of watering the dust, and sums up by saying: "I recommend spraying the water as fine as possible, and keeping someone always at it. Improvement can be noted at once. There will be no water on the roads from this method, but they will remain wet, and the air will be cool and damp. After three months the moisture was seen to climb up into the raise workings. In six months the air in the mine was clear and you could feel the dampness on the faces of the coal, and in some places, see the tiny globules of water. The dryness of the summer months can be overcome by using a fan. Fine spraying all along the entries and roadways is the only way to overcome dust, as it is the only way dust can be dampened; the fact of the water on the roadway helps very little. I know of an explosion from a blown-out shot where there was water the entire length of the gangway and no gas. Fine spraying and keeping everlastingly at it is the principal thing.

"Wetting the face of the room previous to firing is of no material benefit other than that it cools the air at that point. The dust should, of course, be loaded out, but *it is not this dust that carries the danger, but rather the fine dust in suspension* which will ignite instantaneously from the flame of the shot and communicate with that previously deposited on timbers, roofs, sides and in crosscuts.

"The point I make is to dampen the fine particles as they are blown in the air and cause them to settle at once, and settle damp—then it will be easy to keep them damp."

Bearing on this same phase of the spraying proposition, THE ENGINEERING AND MINING JOURNAL, in an editorial in May, 1904, said that the saturation of air in a mine where the main airway may be passing 200,000 cubic feet of air per minute, is practically out of the question. James Ashworth, of England, as has been quoted previously, claims that saturated air is no deterrent against the extension of an explosion, and maintains further that in deep, hot mines, men cannot work in a moist atmosphere, while in dry mines at the same temperature, they suffer but little inconvenience.

Many companies are now using a portable electric pump with hose attachment and are washing down the roof, sides and face of the working places. This doubtless washes down what dust may be then lodged on these surfaces, but unless continuously carried on throughout the mine, would be of small benefit, in entries and haulways.

We now pass to the third method of eliminating danger from dust, the use of "safety," or "flameless" powder. Reference to my Monongah report will show that my chief recommendation at that time was the use of such powder, and I still lay great stress on its importance.

A series of most exhaustive tests, equaled only by those of M. Taffanel, quoted above, have been made by the Department of Mines of Belgium under the direction of Victor Watteyne, and described in a number of brochures published by that department. These tests, however, instead of being directed toward the inflammability of various coals, were in the nature of a study of explosives, for the purpose of determining which, if any, were positively safe. I quote from Mr. Watteyne works: "Certain explosives, to which the admitted theories attributed a high degree of safety, have proved unworthy to appear on this list. * * * The safety of an explosive depends not only on its chemical constituents, but also on its method of composition. One recalls the noted example of Dahmenite "A," quoted by M. Heise, where the charge limit varied in great proportions with the grain. * * I have pointed out frequently during the past 10 years the importance of care in mining coals high in bitumen, calling attention to the very special danger from volatile dusts. * * * Much progress has been made in this regard; the employment of safety explosives which has become common in our mines, has been a great step forward. But the complete suppression of all explosives is quite preferable, and one cannot repeat too often, that safety from explosions can only be obtained at this price.

"Such a complete elimination of explosives seems impossible to realize, but it is possible in more cases than is generally admitted; several who have tried, have succeeded in it. * * * A very important cause of this preponderance of mine accidents caused by explosives is the pronounced influence which coal dust exercises in mine catastrophes, as the mines increase in depth and extent and are, therefore, drier and warmer, and demand more active ventilation. We have also determined from our point of view, that gaseous and dusty conditions forbid the use of slow explosives, * * * even in mines where the most minute investigations of the inspectors fail to show any trace of gas. * * * Whatever be the condition of ventilation in a mine, a certain quantity of firedamp can be disengaged within the confines of the mine, * * * and can be reached by the flames of a blown-out shot before the firedamp has time to become sufficiently diluted in the air.

"It is besides, well established at the present time that certain coal dusts are capable, of themselves alone, or assisted by quantities of firedamp not appreciable by test, of giving rise to grave explosions, and activity of ventilation favors the production and propagation of dusts. * * * Careful tamping of the wad reinforces materially the safety, but its influence varies greatly with the nature of the explosive. It is of minimum benefit with the ordinary charge, relatively weak for mixtures of nitroglycerin, and very high for a strong proportion of ammonium nitrate compounds."

The use of the lead block for testing the values of various explosives originated in Belgium, and has opened up a field of research in this country which is being entered by many of our large mining companies and by experts on explosives generally.

In conclusion, I propose briefly to sum up the decisions at which I have arrived through my own experiments and the compilation of the subject matter here presented.

1. Granting that secondary explosions may be propagated indefinitely by the larger sizes, only coal dust which will pass through a No. 100 screen is capable of initial, or primary, explosion.

2. Such dust after having been subjected to ordinary atmospheric air for only a few hours, becomes largely decomposed, and exists as a bubble of constituent gases, whose film is composed of undisintegrated carbon and impurities, which after combustion are known as ash.

3. Such dust, when suspended in a homogeneous cloud, with a moderate air velocity, is susceptible of ignition either through shock, compression, or sufficient heat to inaugurate combustion.

4. Such results will be classified as combustion or explosion, depending upon the volume of dust ignited, its supply of oxygen, and the space within which combustion takes place.

5. Where gas alone is ignited, and the mine is free from dust, a "high explosive" effect is obtained, and the explosion may be strictly local, due to the cooling effects of the walls.

6. The chief product of a dust explosion is carbon monoxide, whose expansion under combustion is greater than that of methane, and which receives its continu-

ous supply of oxygen by feeding toward the intake.

7. A dust explosion, while assisted by the intake air, must nevertheless follow those entries or airways furnishing the most material upon which to feed, and when this course follows the return airways, the conversion of the carbon monoxide to carbon dioxide renders the air extinctive, and prohibits further propagation. Evidence of such a condition will be found in the coke splashing, or crusts, formed by the deposit of red-hot cinders, carried by the air wave, and testifying to the incomplete combustion.

8. The initial explosion may and generally does, distil so large an amount of gas that complete combustion is impossible at the site of distillation, and this mass of gas and dust, in varying stages of ignition and combustion at a temperature greatly in excess of the point of ignition were sufficient oxygen present, will develop into local explosions at irregular intervals, wherever adequate atmospheric oxygen is available, such as at junctions of airways, widened passages for side tracks, or cavities where falls of roof rock have occurred, and are frequently called "flame areas."

9. When such an explosion, either primary or secondary, travels toward a dead end of an entry or passage, the compression generated by its expansion and momentum causes an almost incredible rise in temperature, sufficient to distil the various hydrocarbons from even the ribs of the coal itself, and supplementing it with a heat potential far in excess of its losses through radiation and expansion.

10. The liability of any coal dust to explosion increases almost directly with its percentage of volatile combustible matter, i.e., the quotient of its percentage of volatile matter divided by the sum of the percentages of volatile matter and fixed carbon.

11. While coal dust alone, under the conditions enumerated, is distinctively explosive, the presence of even the smallest amount of methane augments materially the susceptibility to ignition.

12. On account of the great elasticity of air, it is highly probable that no proper conception has yet been attained, of the almost incredible speed with which a dust explosion, through its gaseous products, may be extended to far distant portions of a mine, under the force of initial expansion, properly called the "percussive theory."

13. Changes in barometric pressure only affect the liability to explosion in so far as they allow, when the barometer is falling, a settling of any possible accumulation of methane from a dome in the roof rock, into the ventilating current; but such small quantities of gas are infinitely safer when diffused in the current of air than when concentrated in one place.

Moreover, even if we grant that a low barometer allows greater occlusion it also allows easier ventilation for the diffusion of such occlusion.

14. A mine may be overventilated until the air-current has such a velocity that it stirs up dust, and would feed any slight ignition which might take place and otherwise die out.

15. The difference in the amount of real dust made by either air punchers or electric-chain machines is so slight, and so variable, depending on the nature of the coal and the skill of the machine man, that it connot be said that either machine, as a class, creates more dust, one than the other.

16. The results of experiments with electric ignition of dust show that the danger from electric wiring is no greater than that of stirring up a cloud of dust from a broken air pipe or a loose connection.

17. Coal dust cannot be made wet, in the usual sense. The method used by superintendent Butler is indicative of the best results, but even then it is hypothetical if the most careful system of watering is not merely an infinitesimal portion of the "ounce of prevention," and it is an open question whether it is not positively detrimental.

18. While the abolition of all explosives, as recommended by the Belgian authorities, appears unnecessary and impracticable in this country, yet the greatest field of investigation now lies along that line, and only those explosives carefully tested, and known to be uniformly prepared, by well known and responsible manufacturers, should be used. The maintenance of a testing laboratory even though on a small scale, and the employment of a competent chemical engineer, should be undertaken at every coal operation of commercial importance.

Why Sulphur Abounds Locally in Certain Coal Seams

By J. R. Heckman*

In recent correspondence with a prominent coal operator the following statement was made: "As to the Bed 'E' coal, I think the greatest trouble with this fuel for coking purposes is the amount of sulphur contained. Bed 'E' does not run regular at any place. A first-class coal may be found at one place, while 50 ft. further on pockets high in sulphur will be encountered."

In assigning probable reasons in answer to the above, I submit the following remarks as relating generally to all coal seams, but especially to the Upper Freeport and Brookville seams in Pennsylvania. I have often noticed the same conditions above mentioned, and from careful investigation am certain that the overlying massive Mahoning sandstone is the cause of the pockety condition in which the sulphur is often found in Bed "E."

The various movements of the earth's crust have caused the sandstone to fracture, and where there is an insufficient slate, or shale cushion, more than the usual amount of sulphur in the coal may be expected; especially is this true at points near any prominent fracture. Where unusual conditions exist, a succession of rolls in the coal seam usually afford these conditions, and from the siltings into the fracture in the rolls, coal from such localities generally yields a higher percentage of ash. At such places the coal appears irregular, or "spotted" in quality.

A Geological Problem

To locate the fracture and its directions, is a problem for the geologist, and when this has been done it seems that the next correct move is for the engineer to arrange the plans for mining so as to leave a line of pillars, or rib, directly under the line of fracture. The following reasons may be attributed for this procedure: (1) These supports would often prevent disastrous rock falls; (2) the pillar, or rib, would contain the major portion of the sulphur pockets, and thus avoid much annoyance. The large amount of iron existing in the make-up of the Mahoning and the Clarion sandstones, is taken up by percolating waters, and uniting with the sulphur results in the pyrites.

A force sufficient to fracture the rocks is also capable of crushing the underlying coal, and provides places for the formation of pockets of sulphur and other siltings. A high percentage of iron in the coal, or the pyrites, gives a reddish ash, and an abundance of "clinker." Where the roof of a coal seam consists of a thin-bedded sandstone, a greater number of minor fractures regularly distributed are noticed; in this case the sulphur has the appearance of being finely diffused through the coal, and is difficult to eliminate.

It should be remembered that in any movement of earth crust, coal is the first to be affected and suffers most. I believe that the pockety condition of sulphur found in all of our coal seams has been assembled by the process above described, and also feel sure that the greatest amount of sulphur is found in coal seams of a friable nature; or that part of the bed which is the least able to withstand a crushing force.

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According to Consul Isaac A. Manning, the United States of Colombia exported $2,011,959 gold; $98,597 platinum; $45,223 mixed gold and platinum; $26,991 gold specie; and $42,084 silver specie in 1907.

According to a recent consular report, the Chinese government has granted a concession to work mines in Hainan, near Hongkong, where gold, tin, coal and iron are known to exist.

A Method for Working a Thick Coal Seam

Great Care Must Be Exercised in Drawing the Ribs and in Preventing the Dirt from Mixing with the Clean Coal

BY GRANVILLE POOLE*

Many are the difficulties to be overcome in working coal seams which are 15 ft. or more in thickness. There is greater danger of falls of roof due to the disadvantage, and sometimes the impossibility, of efficiently timbering and testing. There is again a much greater surface area of coal exposed in thick seams than in thin ones, giving rise to greater oxidation of the coal, and as a result, the liability to more fires due to spontaneous combustion.

It is not my object, primarily, to describe the difficulties to be overcome in getting the coal, but to give a practical instance of how a certain seam with which I am concerned is worked under most unfavorable conditions.

The coal seam contains a dirt parting of a friable nature, and unless great precautions are taken, it is liable to fall and mix up with the lower portion of the coal when that is being removed, leading to much waste. The coal is fiery; and necessarily such a bed must be worked "coming home" or retreating from the boundary toward the shaft.

Mine Is Divided Into Districts

The mine is divided into a number of districts which may be worked independently of each other; they are formed by driving branch roads from off the main entry, 45 yd. apart, to the boundary. "Barriers" or ribs of coal 6 yd. wide are left to separate neighboring districts, as shown in Fig. 2. The workings are divided in this manner so that in case of a serious fire, the burning area may be entirely and efficiently dammed off to prevent the flames spreading. Smaller areas of coal are then left unworked than would be the case if the workings were extended. Furthermore, the ribs of coal that are left prevent the thunderous falling in of the roof, which in some mines has such a fatal effect, causing the roadways to completely close, thus losing the timber and steel supports that have been used. In the South Staffordshire coalfield, these great falls are known as "bumps" and they are nearly always consequent upon the withdrawal of a large area of a thick coal seam. It is often possible to work over the same ground again after the lapse of a few years and remove all such ribs and pillars of coal as were of necessity left to support the roof in the first development, hence the usefulness of making and preserving accurate plans.

When the branch roads have reached the boundary, they are joined by a gate-road *a b* 6 ft. wide. The men then go back 50 yd. from the ends of this road, and drive a second road or "split" across at *c d*. From this split, two roads are driven 15 yd. apart to the boundary, thus dividing the panel into three parts.

The gateway *e f* is now driven parallel to *a b* a distance of 10 yd. away. This road may be driven in each direction from the center roads as well as from the branch roads. The distance, 10 yd., which has been found by experience to be most suitable, is regarded by the nature of the roof as affected by surrounding workings.

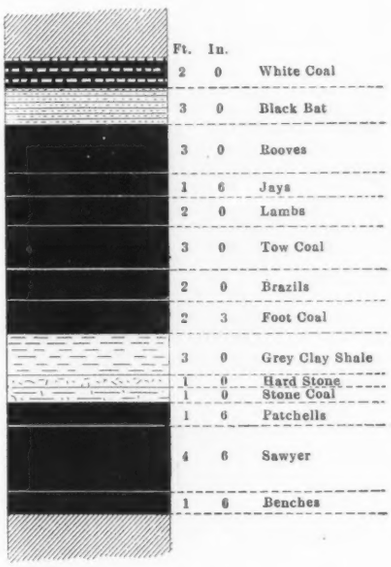

FIG. 1. SHOWING SECTION OF THICK COAL SEAM

Method of Working

From the road *e f*, the whole of the coal below the dirt parting is swept out by stallwork to the boundary rib, this being simply longwall working; the working place is timbered up to the dirt. When the whole of this coal has been removed, the timber is withdrawn from the rear to the front, and the dirt is allowed to drop.

It is well known that a yard of dirt in the solid occupies considerably more than a cubic yard when fallen, but here comes the great advantage of this method of working, for the men just clear the dirt from around the loading places or "bolt holes" *e g n* and *f*, to enable them to get into the opening when the rest is leveled and pulled back. These places are called "bolt holes," because if anything happens in the opening, the men bolt through them with a slightly greater speed than that to which they are so accustomed.

Getting the Top Coals

The next operation is to get out the top coals; these are dropped, layer by layer and loaded out, the roof being timbered as well as possible. The difficulty of efficiently setting long trees on loose ground is overcome in the following manner. To measure the hight of the prop required, the miner usually sticks the end of a tape in a ball of soft clay and throws it up to the roof to which it clings. The loose dirt forming the floor is then prepared to receive a large sleeper or "foot lid," by being leveled and stamped down. A "top lid" is then fastened to the top of the tree by means of a stout nail. The prop is then placed on the end of the foot lid and at the required position in the roof; the bottom of the prop is then driven along the foot lid until it is tight and vertical.

The whole of the top coal, however, is not at first worked out; the rooves, black bat and white coal layers are left up as a roof and timbered to; it being considered the better plan to get out the whole of the coal below this horizon first, rather than interfere with the top coals, thus causing a fall of roof entailing the loss of much coal.

If the former method is adopted, the top coal in the majority of cases may also be dropped and removed. Suppose now that only the rooves and white coals are up: It has been found by experiment that it is not advisable to blast them down, even if they are hard after all the timber has been removed; such a shock is fatal and the sheet crashes in. It is best, therefore, to remove the timber gradually from the rear to the bolt holes, and if the coal does not come in immediately to let it work down naturally or "fret."

Drawing Timbers

The timber drawer is usually an old-timer; he knows his work, which is of a dangerous character, thoroughly. He cautiously removes most of the long trees first, by knocking them out with a "jobber" (a long pole with an iron head), and if they do not come easily, he scrapes away some dirt from under the foot lid, and withdraws them with a "pillar" (a pole with a hook on the end). A sufficient number of trees are left in to protect the man in this operation, and these latter he extracts from a safe position.

Now while the top coal is being re-

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moved in section one, a second relay of men is started to drive another cross-road at *k* and *b* and to sweep out the bottom coal in section two, in the same manner as in the first case, timbering up to the dirt.

In order to keep the roof steady, and in case there may be a fall of sheet in section one, small pillars of solid coal are left at *a g h* and *b*. These pillars—about 4 yd. square—are sometimes found unnecessary; in such cases they are extracted; however, it is always best to leave them until such time when they can be taken out with safety. Another practical point in connection with these small pillars is that the roof pressure is distributed much better if they are not left in regular order. There should be no prearranged position for them, but, as a general view, should appear as in the accompanying figure.

Good timber chocks or cogs are sometimes built, instead of leaving pillars; these cogs form a good support if they are put in in time, for when a weight comes on, the timber just gives a bit and allows the roof to bend slightly, whereas the sides of a pillar grind off. This latter action, besides weakening the support, offers another disadvantage, in that heat is produced by friction which, if not prevented, may originate a fire.

In the same manner, while the top coal in section two is being taken out, a third section is being undermined, and so on. It will be seen that by adopting this method of working, practically the whole of the coal is taken out and very little dirt is loaded out. This compares most favorably with the general method of working thick seams known as "square work," and which was at first the method of working at this mine.

While panel A is being extracted panel B is being prepared, the size being the same, namely, 45x50 yd. In full working order about 40 men are required per panel. Under fortunate conditions, all the coal from the boundary to the main roads may be obtained by thus working in sections, but the coal being of a fiery nature, it sometimes happens that "fire-stink" is detected in the workings coming out of the goaf. The whole of the work is immediately dammed off by four dams, as shown in panel A in the sketch. If this were not done the gas would be so strong on the day after its appearance that the men would be unable to work. In such a case, a "fire rib" about 5 yd. thick should be left intact, forming a complete dam to the area on fire, and giving such roof support as would enable the workmen to commence a fresh section and carry on the work as commenced.

The illustration, Fig. 1, shows the main roads at the bottom; on the left is a district worked back to the main-road rib; in the center, the last panel of a district is about to be started; on the right is a district being opened out at the boundary rib, as I have already described; on the extreme right, roads are being driven out defining a fresh district.

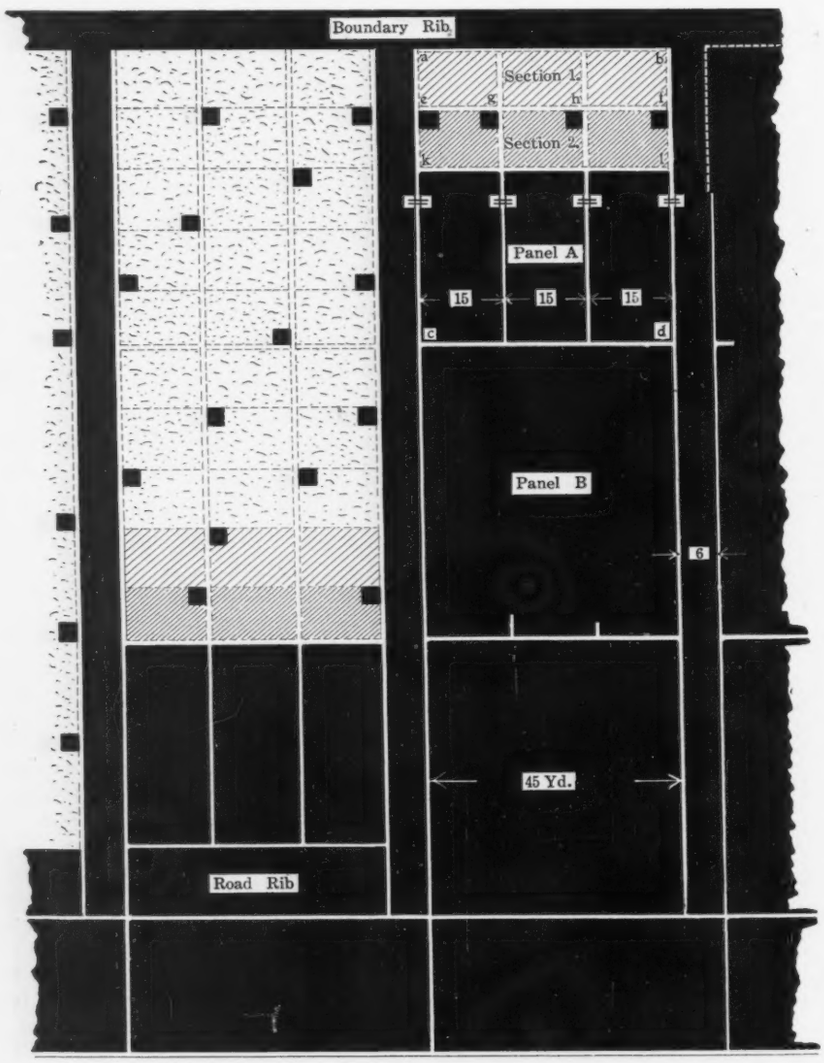

FIG. 2. SHOWING GENERAL PLAN OF DIVIDING MINE INTO DISTRICTS

Gold in the Dominican Republic

The British vice-consul at Santo Domingo reports that veins of auriferous quartz are found all along the central mountain chain, or Gran Cordillera, the richest lodes being always in metamorphic rocks, near the crystalline rocks. Alluvial gold exists along the upper Jaina river, in the province of Santo Domingo; it is coarse and of a deep yellow color, showing a high degree of purity; an assay of 12 oz., made at the United States mint in 1870, showed a fineness of 0.946. In the northern part of the island, that is, on the northern flank of the Cibao, alluvial gold is found in a number of places, especially in streams flowing from the Sierra de Cibao into the Yaque river. The Rio Verde and Sabaneta placers, in the Cibao region, have acquired quite a name, and it is reported that natives washing the gold-bearing sands in bateas, or common vats, have gathered as much as from 5 to 6 oz. a week.

The mines and placers known to exist in the province of Santiago are the Cerro de Piedra Blanca, in Paralimon; San José de las Matas, about one and a half miles from San José, which contains gold and iron oxide; El Pinar, San José de las Matas, on the road to Guava Cuano, containing quartz veins, talc, and gold-bearing schist; Loma de la Mina, in the vicinity of the Magu river, with decomposed gold-bearing porphyry; Las Guasimas and La Cajera in San José de las Matas, containing gold. The principal placers are along the Dicayagua, Bao and Yaque rivers.

In starting a fire under a boiler, the valve should be left open until the steam blows; this assures the expulsion of all air.

Coal Mining By the Retreating Room-and-Pillar System

By Harvey J. Nelms*

The accompanying plan of development shows the general method of driving rooms and extracting pillars on the retreating system of mining. The best general scheme is to have four main entries, two intakes, and two returns for air. One intake is used for haulage and the other as a manway. At the face, it is advisable to have three entries, using the middle one for intake air and haulage. Two butts driven together, with a motor road between every third pair of butts, constitutes the best butt entry system.

The mains should be driven on 50-ft. centers, with 60 ft. of solid coal left standing on each side of the outside entries so as to thoroughly protect the gangways. The mains should be driven perfectly straight as regards sights and should have no angles that can possibly be prevented. It is generally true that only two angles are necessary in developing a coalfield, which can be developed by the mains cutting through the center of the field; the angles necessary are 45 deg. for chutes, and 90 deg. for all entries turned off the mains; also 90 deg. for all rooms turned off the butts. The breakthroughs in the main, should be driven every 125 ft. and kept at a standard distance. Such crosscuts should be driven opposite one another for ventilating and drainage purposes.

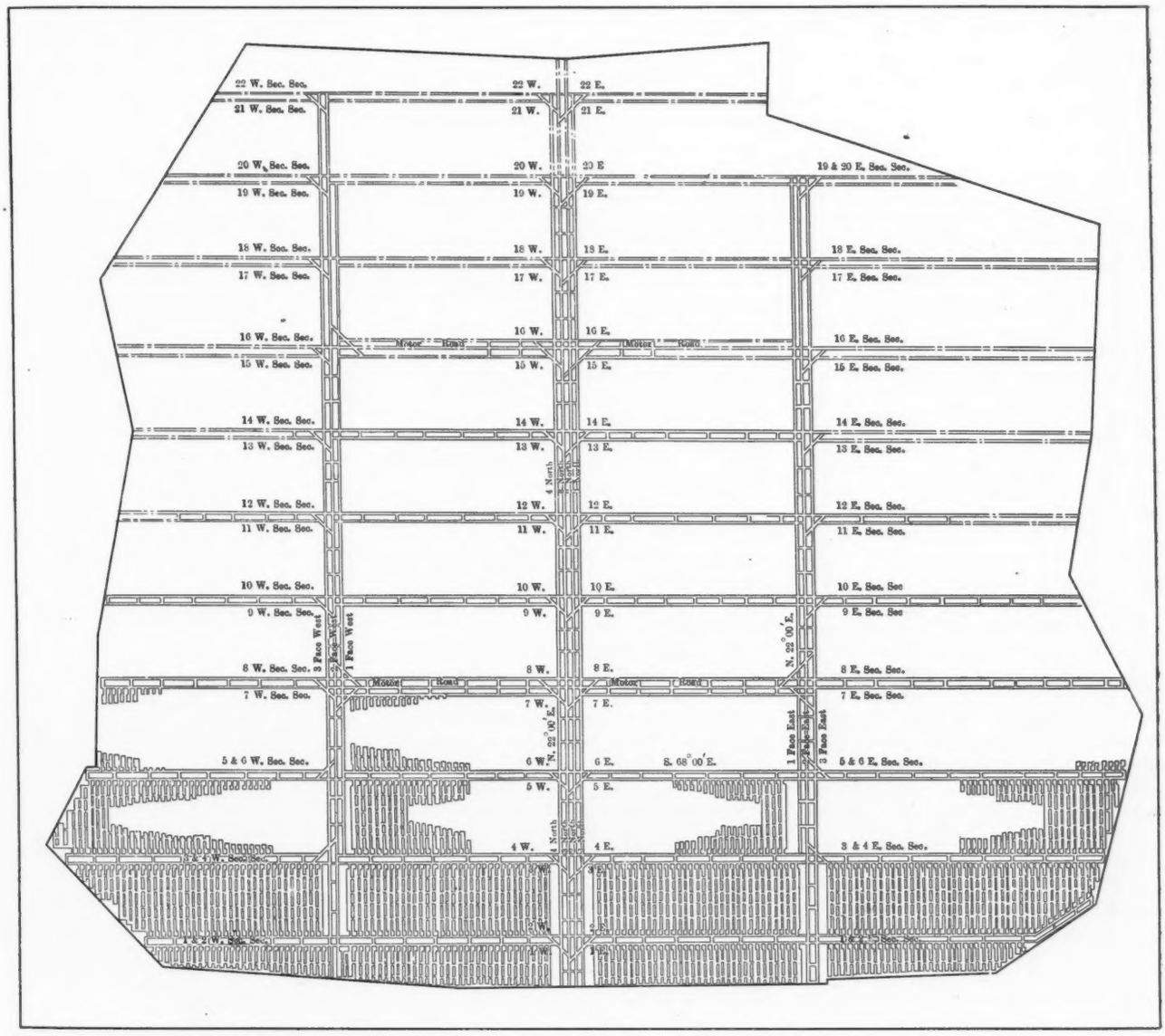

FIG. I. GENERAL PLAN FOR MINING COAL ON RETREATING ROOM-AND-PILLAR SYSTEM

Method of Driving Butt Entries

The butt entries should be turned so as to have 480 ft. of solid coal between two pairs of butts. The distance between centers of butts should also be 50 ft. for protecting purposes as this distance will carry the entries under any kind of top if they are kept in a good condition. The first entry of the pair of butts should start out on a 45-deg. angle for a distance of 26.26 ft. when the 45 deg. is again turned, putting the entry square on the butt course. The parallel to this entry should be turned off at 90 deg., 68.57 ft. from the 45-deg. angle spad. The breakthrough opposite this parallel entry should be driven across the four mains for ventilating and drainage purposes. The small triangle at the base of each pair of butt entries is 18.57 ft. for base and altitude, and 26.26 ft. secant distance. The 45-deg. angle first turned off the main, should be driven on through until it intersects with the 90-deg. angle turned off for a parallel butt entry, as this makes an ideal haulage for both mules and locomotives. The haulage road for the mines, on this plan, is the third main, and the chutes necessary to make an ideal haulage are thoroughly demonstrated.

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Development Should be Started Early

If an operator were to open up his mines, and have his mains started by the time he starts on his tipple, he could be about ready to ship by the time the tipple is ready to run coal. The first pair of butts can be developed as soon as the mains are driven in 250 ft. After turning the first pair of butts, the work should be advanced night and day so that as soon as the plant starts to run coal, it will be possible to turn off rooms from the first pair of butt entries already being driven. It is asking too much of any operator to not run room coal until all of his entry work is finished, so the best plan is to turn the rooms and work on the advance, instead of retreating on his first pair of butts; this room coal will pay for the later entry development until the retreating system can be started. The illustration, Fig. 1, shows the development of a mine, from the advancing to the retreating system.

Rooms Driven On Sights

The rooms should be turned 90 deg. off the butts and sights put up to drive them by. The chambers are worked 24 ft. wide with 15-ft. pillars. The plan of driving rooms on sights should be rigidly enforced as 75 per cent. of the coal lost to operators in western Pennsylvania is caused by rooms having too small pillars between them. This makes it impossible to either drive the rooms to their limit, or to extract all the room pillars after the chamber is finished.

The engineer in surveying his entries, should tie them together at every fourth breakthrough. As soon as the entries are driven, the engineer should establish a base survey inside his mines, and close this survey within a minute. When this is done, the transitman always has something to tie into in making inside surveys, and consequently it is easy to pick up mistakes.

The Electric Wiring

The wiring of the mines for electricity should be rigidly attended to, and the feeders and main power lines should always be put in on an intake entry. When 500 volts are used, 12 in. should be kept between all wires. On butt entries, the positive drive (hot) should be on the inside of the negative (cold) line, and be next to the rib; the insulators of the positive line should be placed in holes drilled on a 45-deg. angle in the corner where the top intersects the rib so as to thoroughly isolate this line and put it where it will do the least danger. If this is done at the start, it will soon pay for the extra labor, as falls of slate or top will not bother the line. The locomotive power line should be strung so that the locomotive can do all its work by using one trolley pole.

The production of iron ore in Japan in 1906 was 40,766 tons; of iron pyrites, 42,155 tons.

Colliery Disasters

By F. A. Hill*

The technical and trade journals have recently published many articles dealing with the causes and remedies for the appalling coal-mine disasters that have occurred during the past year. There is no question that the losses of life from these disasters are out of proportion and vastly more than they should be. Investigations by juries, by committees and by mine inspectors have reported on causes. They include gas, coal dust and falls of roof; still, in a great majority of cases, the immediate cause of the disaster is the human factor. If there were no gas or dust, explosions would not occur.

Aided and abetted by the miner and sometimes by labor organizations, these disasters, in the minds of the public, are placed as the fault of the operator. Is it true? If the human factor was controlled, how often would we hear of an explosion?

Laws are Aimed at the Operator

It is well to have laws and enforce them; rigid laws to compel the operators to keep proper ventilation and provide safeguards. This, the great majority of coal operators would do regardless of any law except the economical one, because it pays to provide good and ample ventilation. Of the laws enacted, 99 per cent. are aimed at the operator; 1 per cent. at the man behind the gun. If the operator does not obey the law, he should be vigorously prosecuted and convicted. If he, for the sake of dollars, should jeopardize life he should be treated as any common murderer, but what about the miner? Of course in most of the explosions the guilty one has been killed; but what about those whose known carelessness is constantly in evidence? How many miners have been prosecuted or convicted for violating the rules governing the operation of coal mines? For every operator thus guilty, there are hundreds of employees, yet the laws invariably are aimed at the former.

All capable mining engineers know that it is possible to reduce these casualties if we could govern the forces that go to make up the vast majority of them. The engineer does govern those that are known: He controls air, dust, and provides safe methods of mining; but does he govern the human element? Are the conditions of the time such that he can do so? All over this great country we recognize the right of labor to organize themselves, to protect themselves in the enjoyment of a lucrative wage, and I uphold this right, and have for many years. What has it led to? Miners' unions are formed, but don't stop at the wage question and hours of work, but provide for many and divers conditions in such a way that the law of the union is superior to the law of the mine or the law of the land. A large part of the time of superintendents and foremen that should be used in looking after the safe operation of the mine, is spent with grievance committees.

Labor Conditions

We also welcome the foreigner to our shores, and put many of them into our mines until there is a veritable Babylon of tongues in our mining camps. Miners cannot read the rules that are promulgated for their safety, and the boss not being a linguist cannot instruct them regarding the peculiarities of the mine in which they work. Under union rules and union domination, there is no room for the old miner who has passed the zenith of his physical ability. There is no room for the man who, taking his apprentice with him, teaches the latter how to take care of his working place, how to mine, where and to what depth to place the drill hole, how to load and fire the shot and at the lunch hour discusses reasons for these things. He is eliminated for the reason that he cannot earn a day's wage by himself or with a helper of like capacity.

There is no discipline about those coal mines that are unionized, and there can be none until the laws of the mine are obeyed absolutely and men are summarily dealt with who disregard the laws of the mine, and until all the miners with all their hearts and souls recognize this law. Union papers give good and timely advice to miners as regards their safety; but they also contain reflections, insinuations and innuendos against the interpretation of the laws by our Supreme Court when the decisions are not upholding the so-called rights of the miner. I cannot recall any case where they advise the miner to obey the laws of the mine and render obedience to his superior officer.

Suggested Remedy

We should have laws that will make miners carry a clearance card showing their ability as miners, and the law should be so constructed that no superintendent could refuse to give a clearance card to any man who has been or is a competent miner, and obeyed the law of the mine. He should have a card stating his services, and his ability as a miner only. This is infinitely better than a certificate received by examination, as he will get a card by reason of his practical and not his theoretical knowledge, and because he has or has not shown by his work that he is or is not a competent miner.

I repeat, lack of discipline has more to do with coal-mine disasters than all the other causes combined. Operators should all stand together for absolute discipline in and around the mine, and until that is had, we may expect disasters brought about by disobedience to rules. Quick and sure punishment should come from infraction of laws, and the miner should see to this as much as the operator.

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Longwall Methods of Mining a Coal Seam

Discussion of an Advantageous System of Coal Mining, Little Used in the United States, but Which Should Be More Generally Adopted

BY LUCIUS W. MAYER*

The most striking feature of mining in the United States, is the infrequent use of the longwall system. This system refers chiefly to coal mining, although, as will be noted later, instances of its use are not unheard of in metal-mining operations abroad.

In general, there are three systems of mining coal; (1) room-and-pillar; (2) pillar-and-stall; (3) longwall mining. The first is by far the most generally employed in the United States, and is operated for every thickness of coal where men can work. The pillar-and-stall system is merely a modification of the room-and-pillar method, the room being approached from the haulage-way by a narrow opening called the stall. This opening may be from 7 to 8 ft. wide and 20 ft. long. In comparison to this, the ordinary room-and-pillar system, the rooms are turned off from the gangway their full width. It is evident that by the pillar-and-stall method, the chamber assumes its full width after passing the stall, which blocks out a pillar, left to protect the roof over the haulage-way from which the chamber has been turned off.

By the longwall system is inferred a method of mining, whereby complete extraction of the deposit is contemplated on the initial attack. There are two general systems of longwall in use, viz: advancing, and retreating, although there are modifications of the system now under discussion. Literature on the subject of longwall mining refers to it in a rather elementary and unsatisfactory manner, and in this country in particular the criticisms are more or less deprecatory.

Location of Longwall Operations

It appears that the advantages of the longwall system are not realized in the United States. Wherever it is used, it is frequently noted that the operation is under the espionage of men with foreign experience. In England the system is operated in more instances than all the other methods combined, and where in America it is used only under ideal conditions, in England the method is operated under widely diversified conditions of roof, floor, inclination and thicknesses of seams.

Longwall may be seen in the United States to fair advantage in northern Illinois, where it is used to a greater extent than elsewhere in America. In this district the seams average about 3 ft. in thickness. A few isolated camps in West Virginia and Kentucky are using the system. One determined effort to introduce longwall in West Virginia a few years ago, on a seam somewhat over 5 ft. in thickness, ended in the abandonment of the attempt, mainly because of the inaptitude of the labor for this particular kind of work. There are a few instances of longwall in Iowa and Kansas, though the operations might hardly be termed prodigious. Colorado is a scene of longwall operations at a place called Radiant, where for some time the system has met with but moderate success.

In Pennsylvania there are two instances of longwall. The Vintondale Coal Company employs the system in conjunction with underground mechanical conveyance, as does the Cambria Steel Company in one of its mines near Johnstown, Penn. In the far West, there are a few places where longwall is operated, as in the State of Washington. Whereas, in Pennsylvania, the seam thickness approximated 42 inches, and the work in the seam was carried on to this hight throughout, excepting roadways, in Washington the beds approximate 4 feet.

The whole of Europe has followed the English idea, and in France may be seen a modified system of longwall operated on thick seam. It is not uncommon to see the system used on seams up to a thickness of 10 ft., and the coal taken in one slice, although with complete stowage. Similarly, the system is used on beds as thick as 30 ft.; in such an instance, the work would be carried on in three slices.

Longwall in Metalliferous Mines

The most general use of longwall is in deposits lying close to the horizontal. Aside from the operations of longwall in coal seams of England, Scotland, France and Germany, may be noted a number of instances on the Continent where the method is used in metalliferous mines. The Mansfeld Copper Company, for example, have for a long time been longwalling the copper shale in Germany. In South Africa several of the banket mines have used the system, though I have not visited this field to verify information to this effect. I understand, however, that on the Black Reef the system has been used, though details on the subject are lacking.

In the United States the occurrence of horizontal deposits is unusual. Sheet ground of southeastern Missouri where the disseminated lead-ore deposits are quite consistent, presents the most consistently flat formation on the entire continent. The sheet ground of the Joplin district, and the Wisconsin fields, may also be mentioned. The possibilities of a modified longwall system for this ground, where the sheets are extensive, is not beyond reason.

Definition of Longwall

In longwall mining in its true form, it is desired to effect a uniform settlement of the roof, behind a continuous working face. To admit of safety at the breast, this settlement should be effected at a certain distance in the rear. There are certain economic conditions which govern the extent to which ground may be kept open between the face and the gob. The control of roof settlement does not figure alone in the safe keeping of the face, but very strongly in effecting the proper breaking of the material being mined.

On the proper control of the roof depends the success of the system. In coal mining, it is usual to undercut, and the weight of the overlying strata lends its assistance in the breaking down of the coal. If the face is not regular, the weight is not exerted uniformly, and the same may be true if the timbers behind the face are not withdrawn in a regular manner.

Longwall Advancing

In advancing longwall, after sufficient coal area has been left at the shaft for its maintenance, the seam may be removed in its entirety to the boundary in all directions. The face may thus take a circular shape, and this is a condition accruing in the Grundy county and Spring Valley fields of Illinois, which former district will be further cited.

It is observed that in advancing longwall, roadways must be maintained in fallen ground, so that the coal may be conducted to the shaft. In true longwall, the structure of these roads is quite devoid of solidity, having been passed through ground thoroughly divested of coal. Ground is maintained by means of walls, built either of rock refuse which may have been stratified with the coal, or else rock is shot down from the roof for wall-building purposes. In thin seams there is usually plenty of packing material close at hand; for example, in a seam of 3-ft. thickness, 2 ft. would be brushed down from the roof in haulage-ways, and the pack walls would be maintained at

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approximately 5-ft. hight. An example of work of this nature may be illustrated by describing a mine in the Grundy county field, which presents a general idea of longwall as practiced in the United States.

The mines are located in a practically flat country, the coal lying parallel to the surface topography. The district is situated about 60 miles west of Chicago, near a town called Coal City. The seam is a bituminous coal averaging 3 ft. in thickness; a typical section of strata overlying the coal would be about 7 ft. of surface soil, 16 ft. of sand, 10 ft. of blue lime, 12 ft. of cemented gravel, 22 ft. of sand shale, 30 ft. of shale, and a bottom of fairly hard fire-clay for a floor. The total depth of cover is usually in the neighborhood of 100 ft. Fig. 1 shows the workings of one of the Grundy county mines. The shaft, represented by *x*, is circular. Note the large amount of ground left to support this shaft.

The size of pillar left to support shafts depends so much on local conditions that no definite figures may be given for this feature. It is quite often found in longwall work of this nature that a figure adopted for size of pillar supporting the shaft is of diameter equivalent to the depth of the shaft. At a glance the difference in magnitude between coal- and metal-mining operations, is observed in this single feature, and the difficulty of comparison of such a system as this for the working of metalliferous beds, with coal as a predecessor, is apparent.

In Fig. 1, *a a a a* called "mothergateways" in England, are driven approximately 280 ft. apart, and practically at right angles to the main haulage road. Room roads *b b b* are spaced approximately 42 ft. apart, center to center. Where the cross-entries *c c c* are turned at 45 deg. from the main roads, the spacing of the room roads is approximately 60 ft., in order to make the 42 ft. of face measured perpendicularly. Entries are maintained 7x7 ft. outside of timbers, except the room roads, which are driven just sufficiently high to allow tramming. In some parts of the field soft ground is encountered, and sets of 12x12-in. timbers have been observed placed continuously and badly crushed, due to the movement of the ground. The maintenance of roadways in advancing longwall under such a condition as above set forth is, of course, an expensive item, and it is questionable whether the system pays when surrounded by such difficulties; however, ground of such a nature as this would be difficult of maintenance in any system of mining.

Referring to Fig. 2, the roof is propped within 2 or 3 ft. of the face. The use of undercutting machines, or running track parallel to the face is precluded by the soft nature of the roof. I have seen roofs so strong that it is quite possible to run several sets of track between the face and the gob, should such a course be desirable; props being set, the miner proceeds to undercut the face with a pick to a depth of 16 to 20 in., Fig. 3, *a*. This undercut is 7 to 10 in. high, and is not made in the coal, but below it in the floor. This procedure, however, is not always possible when the loss, due to the undercutting in the coal itself accrues.

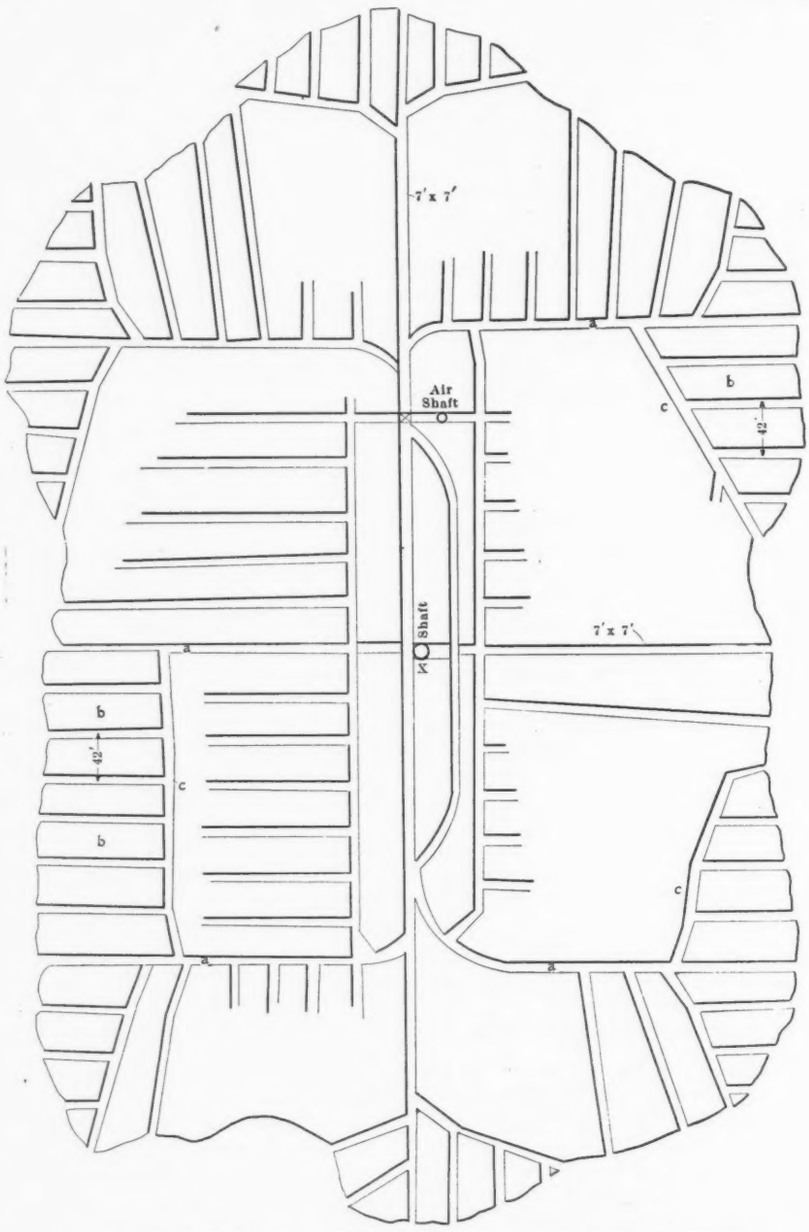


FIG. 1. MAP SHOWING WORKINGS OF LONGWALL COAL MINE IN GRUNDY COUNTY, ILLINOIS

The room track, Fig. 3, *b*, is brought up as close as possible to the face without interfering with the work. Coal between room roads, Fig. 1, *b b b b*, has to be carried along the face, where it is loaded into the cars, Fig. 3, *c*. At the face, Fig. 3, *d*, the back is the hight of the seam, viz: 3 ft., but in the entries the back is brushed down to make head room for the tramming. Walls, Fig. 3, *e e e*, and Fig. 4, *e e*, are built up to the roof, which has been brushed down in the roadway to make a hight of 5 ft. However, these walls, as shown in the figure, are only built to a hight equal to the thickness of the seam, since there is no brushing done, excepting in the roadway.

Between the walls, Fig. 4 *f*, the small material and excess rock are thrown. Where there is an excess of this material, it is hoisted and disposed of on the surface. There is a considerable amount of small material which is useless for wall building. An examination shows that the amount of waste hoisted is 25 tons for every 100 tons of coal mined.

Cross-roads are usually driven about 200 to 300 ft. apart. The length of room roads, however, is more or less arbitrary, depending on the action of the roof and

the facility with which roads can be maintained at length. When the maintenance becomes unduly difficult, a new cross-road is driven and the room roads behind abandoned. Arrangement is made with the contractors who mine the coal, to maintain a certain length of room road and cross-road; 60 ft. of the former and 300 ft. of the latter is a fair requirement, the work of maintaining further extensions devolving on the company. With the formation before cited, it is found that most of the loose settlement occurs during the first two months, this subsidence taking place in a gradual manner. The surface rights are leased with the understanding that subsidence will occur. Pillars are left in the usual manner, to support important buildings on the surface, but elsewhere the entire country is lowered.

In contrast to the operations above cited,

FIG. 2. SHOWS SUBSIDENCE OF ROOF BETWEEN ROOM-ROADS

which are considered typical of the longwall system in America, may be mentioned an instance of an advancing system in England, where the seam is 7 ft. in thickness, with but a 4-in. band of slate; the pack-wall material having been drawn entirely from the roof rock over this 7-ft. seam, is shot down in a systematic manner in the roadway and carefully built up in regular form by experienced wall-builders. This roof rock was an exceptionally strong sandstone.

Retreating Longwall

In general, retreating longwall infers the driving of entries to the boundaries and working home to the shaft. The roof is allowed to subside behind the area temporarily supported to maintain the working face. As in any system of longwall, more or less timber is required at the face depending on the nature of roof, which may or may not permit of economic maintenance of track between face and gob. A good condition, in any event, is when there is always sufficient space open between coal and gob to admit of a person walking continuously around the face. It is then assured that the ventilating currents have free sway and that the face is in good condition.

Comparison of Retreating and Advancing Longwall

In comparing the two systems, it may be said for the advancing system, that a quick cash return is available. Whereas, with the retreating system, particularly where seams are thin, and there is considerable rock waste to be mined in the roadways, this feature may involve considerable delay, since the headings are usually driven to the boundaries before mining proper is started. In advancing longwall, the haulage-ways are in ground which is artificially supported, whereas, in retreating work, the roadways are always in the solid, the fallen ground being left to rest behind for all time. This feature of the retreating system is a marked advantage. Following the subsidence of roof, shrinkage of the pack walls, and the upheaval of the floor, it often becomes necessary to brush down the roof, pull up floor and retimber to maintain the proper hight of roadways in the advancing system.

Since the roads are subject to these conditions, it is evident that constant attention is required, but the seriousness of this matter depends entirely on the nature of roof and floor, which subject will be discussed later. It would appear that with the advancing system, a strike or other cause precluding proper repairs to the roads, may under certain conditions render them impassable, and eventually these passageways would have to be reopened, perhaps at large expense.

It is remarkable to note in some formations how fallen ground will consolidate, and where one would anticipate the necessity of a complete forespiling system of timbering, it is often found quite practicable to support fallen ground with ordinary drift sets much in the same way as the original ground. Where the roads are in packed ground, in the event of a sudden squeeze or other accident, the roads may be rendered useless for escape, wherein lies a disadvantage of the advancing system. It may be said, however, with regard to such squeezes, that they are quite unlikely, since the longwall system involves at the outset a regular subsidence of the roof, anticipating control of both roof and floor. The effect of squeezes in room-and-pillar work is well known to be usually due to the carrying out of the bad policy of leaving pillars too small as compared to room area, which leads to difficulties accruing in the progress of pillar-withdrawal operations. The frequent occurrence of accidents, leading to the rapid destruction of pillars and the terrific efforts required as a rule to save this action, cites an advantage to the longwall system.

In advancing longwall, the roads probably require more timber in the long-run than in retreating, since they must be kept open in certain locations until the area is depleted to the boundary. The faster longwall can be driven, the better the roof conditions under which the men are working, for as the face advances, new roof is being constantly exposed. This point of speed also figures to an extent as regards timber, for the less time the roof is given to assert its weight on the supports, the more readily will their removal be effected.

Features of Longwall

In general, by using a longwall system, less coal is exposed to the action of the atmosphere. In room-and-pillar work, pillars may stand for years, before being removed, if they are removed at all. Not alone does the action of the air ameliorate the quality of the coal, but dangerous gases in longwall workings are seldom exposed. Retreating longwall in particular, favors good ventilation, especially at the face. Explosions due to accumulated gases in longwall workings are seldom heard of. In retreating work, this feature is emphasized because there is no reason to return through a fallen area, as in advancing longwall.

Accidents due to roof falls are less prevalent in longwall work than any other system of coal mining. This applies particularly to the United States, for there, as stated previously, only the thinnest seams are worked longwall, and a low roof can always be more readily tested than a high one. In France, where the roof is of 10 ft. hight, over a longwall face, bad conditions were involved since this roof was of a scaling nature and the most thorough timbering was necessary. The coal was friable and even the face was timbered with plank excepting at those points where the men were picking the coal.

Experience has shown that where a large production is desired from a given area, the same may be accomplished in a shorter interval of time with longwall than by the room-and-pillar system. In general the production per man per shift in longwall is greater, and the cost of mining per ton, under certain conditions where both longwall and room-and-pillar had been operated, favored the former system, to say nothing of the higher extraction of the coal deposit.

American coal engineers in general show disfavor for the longwall system, despite the great success with which it has met in Great Britain, and the following that

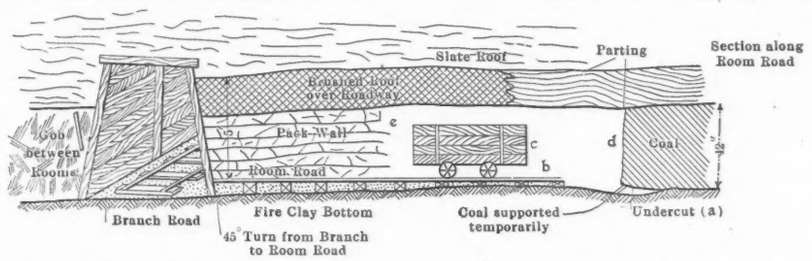


FIG. 3. WORKING LONGWALL IN ILLINOIS. SKETCH SHOWS UNDERCUT AT FACE

other nationalities abroad have given the Britishers. The prevailing opinion in the United States is that the system is impracticable where the seam is over 5 ft. in thickness, and it will be then also inferred for an advancing system particularly, that sufficient packing material is stratified with the coal to supply wall-building material. The maintenance of roads in advancing longwall is severely criticized as an item creating a large expense. This condition is quite true, but depends entirely on the nature of roof and floor, so that the inference is not at all general.

The main objection to retreating longwall relates to the tying up of capital for an undue period. This objection considers that in all cases the roads must be driven first to the boundary, as is true in the typical longwall system of this form. However, a combination system of both advancing and retreating longwall may be operated often, and this objection thus mitigated, where speedy monetary returns are so urgent.

Nature of Roof and Assistance of Roof Pressure

There appears to be considerable diversion in opinion among the authorities as to whether a hard or moderately soft roof is preferable to the longwall system. In this country the latter is favored decidedly, but I venture to state that there are roofs in England, which, though successfully manipulated behind a longwall face, would be considered in America wholly beyond the province of longwall mining.

It would be difficult to state whether an infinitely hard roof would be easier of control than an infinitely soft one; the latter is the one most frequently encountered over coal seams. In this connection a peculiar condition seems to exist the world over, that the roof over coal seams is considerably harder than the floor, and only in a few instances has it been noted that both the roof and floor were of the same material.

It is of prime importance that the face be maintained safely and with comparative ease, in order that the quickest progress may be made. A soft roof will require more attention and more timbering than a hard one. With a hard roof there is often considerable anxiety felt in obtaining the first break, which, however, when once accomplished, permits the roof subsidence behind the face to be readily kept under control. Large areas have been known to hang, which, when they have finally fallen, created more or less windage. Investigation of this subject has proved that this windage is never so strong as to be really dangerous. In the Bengal seams of India, which are thick, and mined from under sandstone roofs by a modified South Staffordshire method, heavy falls of roof have occurred covering large areas. Due notice of the impending fall is always given in the nature of local scaling off of roof rock, and the men have been known to remain in the mines, not far from the active areas, during the period of a fall without sustaining any injury.

It may seem an extreme statement to say that no roof is too hard for longwall, but from work observed, it would appear that no roof found over coal is so hard that longwall cannot be operated successfully, other things being equal.

Where a roof is so strong that it will not break within a reasonable area, one of the objects of longwall is defeated. The occurrence of the first break in the roof is a sign that the lateral compression in the overlying masses is relieved. Where there is no break there will be practically no weight on the face, and consequently no assistance of the roof in the breaking of the coal. It is not to be inferred that power is unnecessary in longwall mining, but even though a steady pressure of roof is obtained, and the coal be undercut, a certain amount of blasting is usually required to break down the coal at the desired moment.

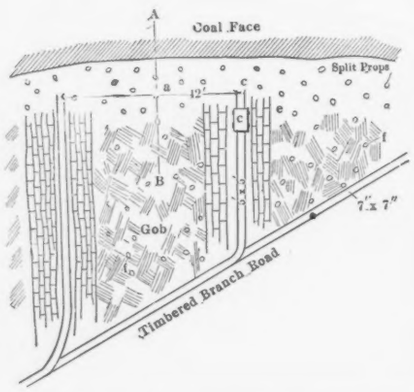


FIG. 4. SHOWS ARRANGEMENT OF PROPS AND TRACKS AT COAL FACE

While the condition of an infinitely strong roof is rarely heard of over coal measures, yet if such a condition was met, and although the assistance of roof pressure to break the coal at the face might be lost, the feature of a high extraction of the deposit would still be attainable, and there is no question but that the best way to mine wherever possible, is to make the first attack on the beds the last attack, wherever same can be accomplished in an economical manner.

Roof falls are not always accomplished by the dislocation of the main strata, but more often consist merely in the peeling off of roof strata below the outline of the dome formed in the caving. In longwall with a yielding roof, the ideal action is one of bending of the formation, which acts on the face cantilever-like. With a strong roof, which hangs, the peeling action above mentioned might occur locally and must be guarded against. If a fall included the main roof strata, no amount of artificial support could counteract it, but the peeling action of the strata below the dome line could be readily supported with props. In Europe it is generally advised that no matter how safe a roof may appear, it should be timbered thoroughly, for the mysterious actions of roofs have been the occasion of more fatalities than any other cause.

Surface Subsidence

Surface subsidence usually follows roof falls underground. The severity of this subsidence depends on the thickness of the seam, the nature of overlying strata and the depth of the seam below the surface. It is well to always anticipate disturbance of the surface, even though the area is completely packed. It has been shown, however, in this regard, that where packing material has been introduced by means of water, such an intimacy can be effected between the particles making up the filling material that surface depression is hardly noticeable, where formerly the introduction of the filling in a dry condition resulted in considerable shrinkage and marked surface disturbance. No matter in what manner an area is replaced by a packing material there will always be some shrinkage, for the replacement medium cannot be made as solid as the original material occupying this space.

With longwall where surface subsidence ensues, roof lowering is attended with considerably less disturbance on the surface than with pillar work, since the work underground is carried more regularly and the face advances with more accurate alinement and more gradual lowering of the roof. In longwall the roof is watched more carefully, for so much depends on its proper control. This feature should not be minimized in room-and-pillar work. In pillar robbing, however, it is not aimed so much to throw the weight of the roof on the coal, whereas in true longwall this feature is part and parcel of the system. In robbing a pillar, the timbers are usually left standing long enough to admit of as nearly complete removal of the coal as possible. While there is some regard paid to the future of neighboring pillars, if the work is carried on conscientiously, the roof is finally allowed to fall, if it will, in virtue of the removal of the timbers.

In America, while the filling system is used, as will be discussed in a future article in detail, it is rarely introduced in conjunction with the robbing system, but rather as an auxiliary support for the pillars which were not properly arranged in the original layout. In longwall, when the timbers are withdrawn, it is desired that the roof shall come gradually to rest on the packwalls, whereas in pillar-robbing work, the roof falls to the floor. True, with a soft floor in longwall the packs are often driven into the floor, but this action is not a sudden one, and the

overlying strata when it does subside does so in a gradual manner.

TIMBERING

Every effort should be made to recover timber and where possible to reuse same. In longwall work, it is most important that all standing props be removed in a systematic manner as the working face advances. With certain roofs, a few standing props may interfere with regular roof subsidence. It is not unusual to see a small prop standing in a thin seam and the roof bending about it, finally reaching the floor. A roof formation of this kind would be considered favorable for the longwall system, in virtue of such a possibility.

Where the roof is hard and the floor comparatively soft, or *vice versa,* a much better condition for ideal longwall obtains than where both are hard. Where a hard roof has taken weight, with a hard floor under it, timber removal may become extremely difficult. The withdrawal of props in such an instance often entails blasting, or otherwise destroying same, to effect its dislocation. With a soft floor, the props might be forced well into it, and their recovery is not such a remote possibility. By tapering the props at one end, the action due to the fracture of timber has been ameliorated. By this tapering the compressive action of the roof, when taking weight, is localized in the tapered area of the prop, which is caused to bur. This burred part may then be sawed off and the prop reused, at a point where a shorter stick is required. Such a form of prop is greatly favored in certain parts of England. It is also found expedient in setting a straight prop, to pile an amount of small broken stone under it, which, when picked away will admit of readily removing the timber even though the roof has taken weight.

A closer study of the longwall system on the part of American engineers would no doubt evolve some interesting innovations in its application. Up to the present time, however, comparatively little thought has been given the subject in the United States, which is strange in a country where speedy and total extraction of deposits is generally looked to, and extreme means usually pressed into service to effect this result.

The control of a hoist should be such as to entail the least possible amount of physical exertion on the part of the engineer. He should be free from the constant demand upon his physical energy to operate and control the engine, so that his mental faculties may be properly concentrated upon his work. For this reason, hoisting engines should have easily operated steam valves, quick to open and close, steam-actuated reversing gear and powerful brakes capable of holding the engines under the most unfavorable circumstances.

Nickel Ore in Nevada

SPECIAL CORRESPONDENCE

The principal development of nickel ore in Nevada has occurred at the Key West mine, in the southeastern part of the State, about five miles west of the Utah boundary. The ore is confined to rounded masses of diabase intruded into crystalline schists, the former being very much like the basic rock of Sudbury, Ontario. The diabase weathers rapidly, forming a greenish black, powdery mass. Chalcopyrite is the prevailing mineral, the ore averaging about 3.5 per cent. copper, 2.5 per cent. nickel, 1 to 3 oz. silver, and 0.25 to 0.30 oz. platinum per ton. It does not contain gold.

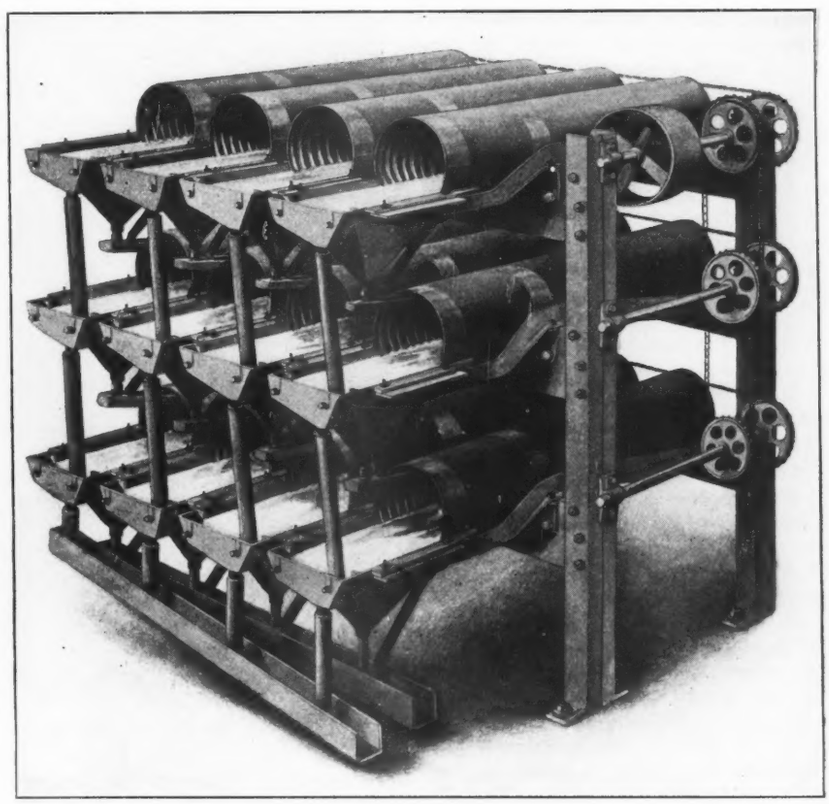
The first work on the property was an incline dipping 12 deg. into the outcrop of one of the lenses; a second incline, at right angles to the first, and starting about 150 ft. from it, was sunk at a dip of 30 deg., developing a body of ore which varied greatly as to outline and metal contents. At 300 ft. from the first incline a shaft was sunk 110 ft., encountering a mass of ore which was cut off by what seemed to be a fault but proved afterward to be only the smooth exterior of the mass. A second shaft was sunk 150 ft. from the first and encountered two additional lenses. A long crosscut was then driven to get under the first shaft, but after passing through the first lens it found nothing but the undisturbed crystalline schists.

There were two reasons why the property was not further developed at that time, viz., (1) the distance from transportation and the high cost of operating, and (2) the difficulty in disposing of a copper-nickel-platinum matte. The mine is now within a reasonable distance of the railroad, and it is rumored that a matting furnace is to be erected in the vicinity.

The Improved Macquisten Tube

BY W. R. INGALLS

In an article in the JOURNAL of October 26, 1907, I described the Macquisten tubes used for concentrating ore by a flotation process at Golconda, Nevada, and mentioned that it was planned to group the tubes in a more compact way. This has recently been done, as shown in the accompanying illustration. The apparatus is made two or three tiers high, and the floor space required is only 6x7 feet.



IMPROVED MACQUISTEN TUBES

Diamond drills have been installed on the property of the Mammoth Channel Mining Company at Magalla, Butte county, Cal., to test the gravel and find the exact depth of the channel. It is expected to reach the gravel at about 600 ft. depth. The drainage tunnel, now 1200 ft. long, is nearly completed.

A New Machine for Use in Room-and-Pillar Work

The economy and speed with which coal is mined by longwall machines has given rise to a large demand for an efficient machine operating on the longwall plan for room-and-pillar work. Special interest therefore attaches to the announcement that the Jeffrey Manufacturing Company has added to its line of electric coal cutters a new room-and-pillar machine, known as the Jeffrey 26-B Shortwall Coal Cutter, details of which are shown in the accompanying illustrations.

The difference between this and the many well-known breast machines, is largely in the method of cutting. The new type cuts across the face of the coal, starting at one side of the room and not stopping until it finishes the cut at the other side.

Method of Operation

A ½-in. steel feed cable wound upon a power-driven drum at the front end of the machine pulls it across the face of the coal at a speed dependent upon, and suited to, the hardness of the cutting and the nature of the coal or clay in which the cutting is done. This drum when desired can be disengaged by means of a suitable clutch, so that the machine in finishing its cut at the left-hand rib may be angled for the purpose of maintaining a uniform width of room. Another cable, having no connection whatever with the power, is arranged to act as a guide to hold the machine to its work at a proper angle for its greatest cutting efficiency.

Suitable sheave wheels are provided at convenient points on the machine to guide the feed cable so that it can be led off in any direction, thereby enabling the machine to be loaded, unloaded, moved about and pulled out from under the coal by its own power; this is a desirable feature, and one which strongly appeals to machine runners. The gearing is arranged so that the feed drum may be operated at a sufficiently high speed to move the machine quickly about the working place. To take care of the heaviest service, an exceptionally powerful compound-wound motor is provided.

The operation of the machine may be briefly described as follows: It is brought into the room on a truck moved by its own power or hauled by a mule, depending on whether or not a self-propelling truck is used. A pipe jack is placed at the face of the coal at the right-hand rib and the feed cable attached. The motor is then started and the machine moved to the face of the coal. A simple guiding device, consisting of a piece of tee-rail and one jack, is then set up on the left-hand side of the machine and the sumping cut is started; the feed cable pulls the cutting frame in under the coal and the guiding device serves to hold the machine in line.

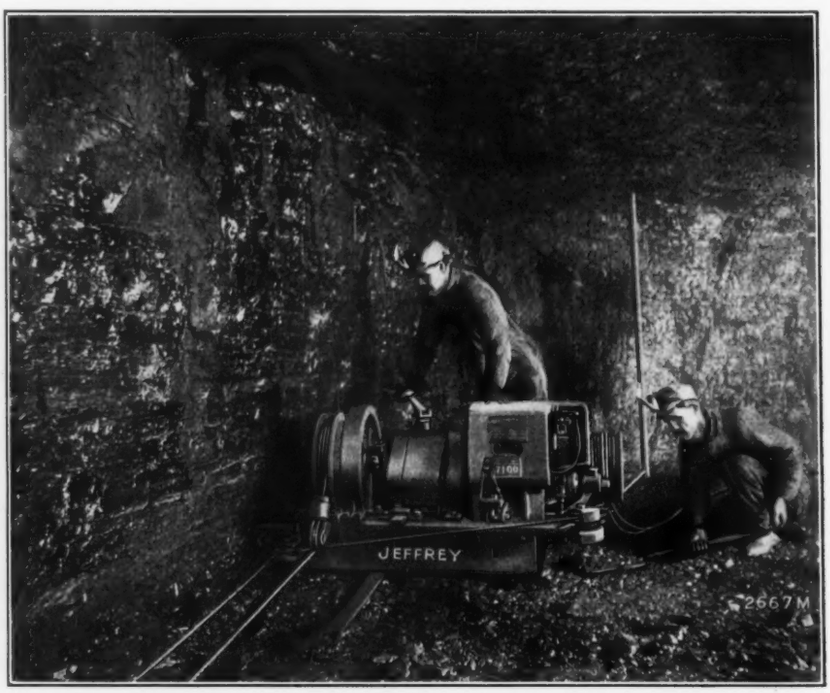
When the sumping cut is completed, a steel anchor hook is secured by a wedge in the left-hand rib near the face; to this hook are fastened one end of both guide and feed cables which lead across the face of the coal. The cable is then attached to a jack set at the right-hand rib in line with the rear drums, and the machine started across the room. In operation, the feed cable pulls the machine across the coal face, and the guide cable keeps it at the proper angle to the face of the coal.

A special flexible brand of wire with elliptic stranding is used for the feed and guide cables, eliminating any tendency to kink or curl up when the tension is released, and materially increasing the wearing surfaces of the cable. The elasticity of the cables equalizes the shocks and jars on the machine and gives the motor an even, steady load.

(4) it consumes but a small amount of power per cubic inch of coal cut; (5) it is handled by its own power with rapidity and with little exertion on the part of the machine runners.

In addition to the machine described, the Jeffrey company also builds a side cutter for thin seam coal, the construction and operation of which is essentially the same, no advantageous features being sacrificed to obtain the reduced hight. Both machines cut directly on the floor of the seam.

The motors furnished with these machines are of the best modern and improved types. The frames are made of cast steel with laminated pole pieces. The armatures are drum wound with form-wound coils. The field coils are series wound with insulating compound and are inclosed in oil and moisture-proof covers.



THE JEFFREY SHORTWALL MACHINE AT COAL FACE

Advantages Claimed for the Machine

When the machine reaches the left-hand rib, the pipe jack is moved to a position near the truck, the feed cable attached, the machine pulled out from under the coal and over to the truck where it is loaded by its own power and is ready to move to the next working place.

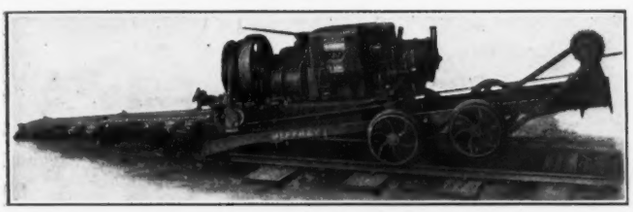
Among the advantages claimed for this machine are; (1) its construction is simple and strong throughout, and the power of its motor equipment is large, qualifying it to perform long and hard service and greatly reducing the danger of breakdown and cost of up-keep; (2) it cuts fast, and but little time is consumed preliminary to starting up and in removing the machine after the cut is finished; (3) it occupies little space and permits setting the props nearer to the face of the coal; The commutator bars are of the best quality of hard-drawn copper, and are insulated with mica of the proper hardness to insure even wear and long life.

At Robinson and Kokomo, in Summit county, Colo., bodies of argentiferous galena, pyrite and blende, and above the water-level their oxidized products, occur at the contact between Carboniferous limestone and an overlying sandstone, or at the contact between the limestone and sheets or dikes of porphyry. These mines were discovered in 1880, and for a few years were worked on a considerable scale, several smelting works being erected in the district. The mines proved disappointing, however, and were soon for the most part abandoned, although work has been continued in the district to the present time.

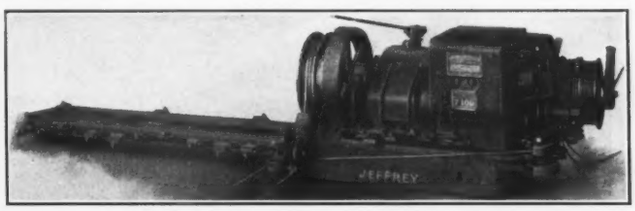
Mine Mules and Their Care

By Robert Grimshaw*

It is generally stated by those who have to do with mines, that horses and mules which work a long time underground become blind when brought again into daylight. Veterinary surgeon Sturm, of Gergany, investigated not only this, but also the question of cruelty to such animals. In the latter particular, Dr. Sturm thinks that all reproaches are undeserved. He found that in almost all cases there was ample provision for inspecting the horses with regard to their health and freedom from the pest. It was observed, however, that there were a great many cases of eye-disease; 90 per cent. of these being of one eye, and 10 per cent. of both eyes. Where there was any indication of cruelty to animals, it was in the case of an animal that had bad sight. This difficulty does not prevent the animals from making the regular trips; but in sudden turnings, or by the sudden appearance of a bright light, they would often be shy and show themselves uncertain. This state of affairs too often led the driver to ill-treat them, as the reason for the lack of obedience was unknown.



General Method of Conveying and Unloading the Machine



Coal Cutter Ready for Operation

JEFFREY SHORTWALL MACHINE

Causes of Blindness

On first investigation, it was thought that most of the cases of blindness were caused by blows on the head in running against obstacles that could not be seen in the galleries; this opinion was soon changed and the many scars and cuts on the forehead and eyebrows of the horses were found to be the result, rather than the cause of the trouble with the eyes. In 80 per cent. of the cases the animals suffered from cloudiness and degeneration of the lens and the vitreous fluid of the eyes. This cloudiness (gray cataract), shows usually a gray-white or gray-black and sometimes even gray-green color, and is of various forms. There are grays and blues, also moss-shaped or root-shaped figures and branched patterns. In many cases there are smoky, beam-like cataracts, and within them, and beside them, scabby or black grainy, cloudy places in the lens. In some instances the cloudiness was caused by "synchysis scintillons" or liquefying of the vitreous substance. Especially where the head was suddenly raised, one would see in the background of the eye numerous glistening crystals, dancing about like snowflakes in the wind.

Cases of inflammation of the lids, cornea and iris are also to be found, but usually heal rapidly without any inflammation of neighboring portions. Also shrinking of the entire eyeball and general inflammation of the whole eye are often found. The more seldom cases of slight cloudiness of the cornea are mostly caused by examination with an ordinary mine lamp. The horses allow themselves to be inspected with such lights, while, bringing an electric lamp near, causes restlessness. The tests showed as a rule slight adjustability of the iris, and abnormal size of the pupil. Changeable light causes only slight pupillary reaction, even when the lamp is brought very near to the eye. As inflammation cannot be assigned as a reason for this, the diminished adjustability of the iris must be attributed to paralysis of the retina. In only two cases was the roundness of the pupil altered, where the lens was misplaced. Such a misplacement of the lens into the rear chamber of the eye was observed by Sturm for more than a year. The horse was brought to him for treatment, and alluded to as "the one with a little button." For about four months after the commencement of the trouble the lens got gradually more and more cloudy, so that a great white chalky button projected into the pupil. Only after a year was there any cloudiness of the other portions of the eye.

An Analysis of Common Eye Diseases

The question now is, what is the cause of these frequent abnormal diseases, especially of the lens and the vitreous medium? This is best answered by Sturm by giving particulars of one mine which he inspected. The horses on their way toward the shaft, hauled on an average, eight cars, each of 12.5 cwt.; the haulage distance was about 1600 m. or an English mile, up a grade of 1 in 500, and at a speed of 1 to 1¼ m. per sec., or say 2 to 2¾ miles per hour. Against this trip, there was a strong draft of fresh air coming in at the rate of 4 m. per sec., or say 7 to 7⅓ miles per hour, and at about the temperature outside the mine. The horses often came warm, or even hot, from the cross-galleries into the neighborhood of the shaft, and would then stand before a door opening, having a temperature of 65 deg. F. When this door is opened and the train is hauled further, there is often, in winters a sudden cooling, to as low as the freezing point. The draft in this section is strong, so that a person must hold his hat. Even in the crosscuts it is difficult for a miner to keep his lamp burning, because of the draft. The return trip with the empty cars in the direction of the draft follows immediately; and usually the out-trip with loaded cars comes at once after the return with the empties.

Results of the Variation in Temperature

This variation of temperature, and the strong draft, are the principal causes of the inflammation of the eyes. It is a well-known fact that cold, as well as heat, can cause inflammation of the lens, as shown by Midnel. He was able, by placing an ice bag before the eye of a healthy animal, to cause an opaque cloudiness of the lens, which, on removing the ice bag, became clear again. On the other hand, glass workers who are subjected to intense heat from one side, are subject to gray cataract on that side. Therefore the above described disease of the lens and the vitreous medium are shown to be caused by disturbed circulation and nourishment.

As regards the paralysis of the retina, one must take into account that the animals (in contrast to the miners) are usually, and sometimes continually, away from the light. The mine lamps and the little electric incandescent lights only partially replace the sunlight; so that paralysis of the retina takes place.

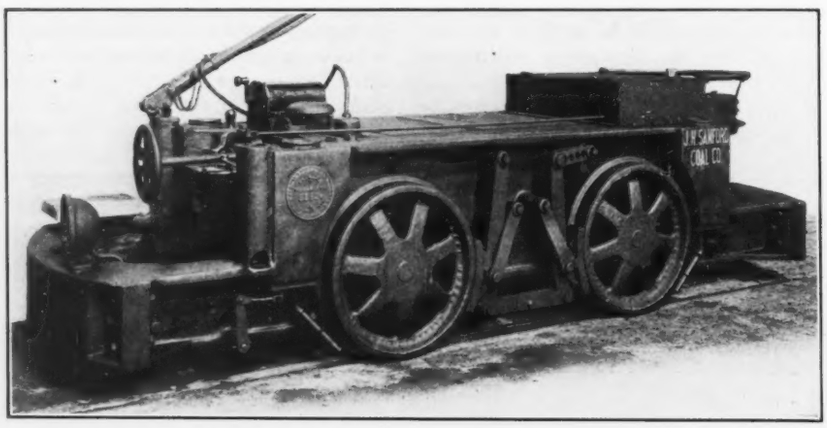
In this connection, no reproach can be made to the management of the mines. These difficulties must be regarded as inseparable from the business. The matter might be bettered somewhat by bringing the fresh air from above toward, instead of from, the hoisting shaft, as is already done in some mines. The stables underground are often better than those above; but for all that, the animals should perhaps have a change of work from darkness to daylight from time to time. In this way at least, the retina could be kept active, and thus be a less frequent cause of other troubles. Much cruelty to animals could also be prevented, if those that are considered as shy, or balky were oftener inspected. Once the reason for shying is made known to the driver or hostler, much mishandling would be prevented.

*Engineer, Dresden (A), Germany.

Recent Electric Locomotives for Mine Haulage

The extensive use of electricity as a motive power in mine haulage, is proof of the fact that its employment has passed the experimental stage. The electric locomotive is compact and simple in construction, emits no smoke or gas, and does not impair the sanitary condition of the mine. The same source of power that drives the locomotive can also be used for operating fans, pumps, hoists and other machinery. By combining the power requirements in this way, the load fluctuations are reduced and the entire plant can be economically operated.

The accompanying illustrations represent locomotives for mine service recently built by the Baldwin Locomotive Works, and equipped with electrical apparatus supplied by the Westinghouse Electric and Manufacturing Company. The locomotive for the J. H. Sanford Coal Company is one of three recently supplied to this concern. These engines represent the type usually built for mine service, and are particularly interesting as they are equipped with traction reels. The gage of track is 3 ft. 6 in. and the approximate weight of each locomotive is 12,000 lb. The wheels are of chilled cast iron 28 in. in diameter and spaced 4 ft. 4 in. between centers. The journals are 3¼x4½ in. The frames are placed inside the wheels, and are of cast iron, with bumpers of the same material.



BALDWIN-WESTINGHOUSE MINE LOCOMOTIVE WITH TRACTION REEL ATTACHED

Locomotives Have Traction Reel Attached

This locomotive is equipped with two No. 60 motors, suitable for 500 volts pressure. The motors are inside hung, that is, suspended between the axles. They are rated at 15 h.p. each. Operating equipment is provided at one end of the locomotive only. A trolley-pole socket is cast in each frame at the operating end of the locomotive.

The traction reel is used for hauling loaded cars from the room face, the locomotive remaining on the main track with brakes set. The reel is mounted vertically on a crosstie at the rear end of the locomotive. It is driven by a Westinghouse K- 2 motor, which is mounted on a projection of the reel housing and operates the reel shaft through bevel gearing. The body of the reel is of cast iron and is wound with 300 ft. of ⅜-in. steel cable which can be readily payed out when it is desired to haul cars. The device is operated by an auxiliary controller, placed within easy reach of the motorman. The reel motor is covered by a hood which can be opened on top, thus giving ready access to the equipment.

The approximate over-all dimensions of this locomotive are: Width, 4 ft. 2½ in.; height, 3 ft. 8 in.; length, 12 ft. 4 in. The equipment includes hand brakes of the screw type, and four sand boxes cast in the frames with spouts to all the wheels.

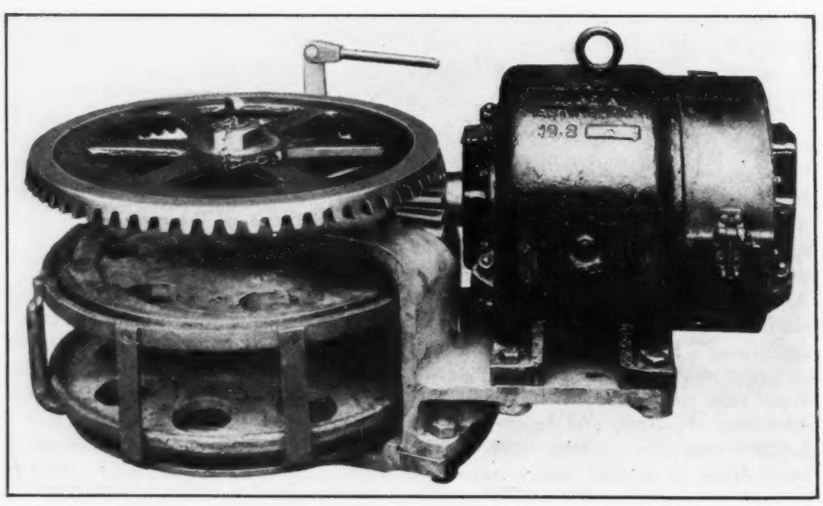
The United States Coal and Coke Company has recently received five Baldwin-Westinghouse locomotives, which are arranged to operate either individually or in tandem. Two of the machines are arranged as leading units, and three as trailers. The leading units are equipped with four motor controllers, so that one man can readily operate both locomotives. The brakes are operated by levers and when working in tandem they are connected by a chain which is guided around sheaves suitably mounted in the bumpers. The illustration shows a leading and trailing unit coupled together.

The track gage is 4 ft. and the weight of each locomotive is about 26,000 lb. The wheels are 30 in. in diameter, of cast iron with chilled treads and spaced 4 ft. 8 in. apart. The frames are placed inside the wheels and are supported on coiled springs placed over the boxes. The journals are 3¾x6 inches.

Each locomotive is equipped with two No. 115 motors, of 75 h.p. capacity. The motors are inside hung. The width of the locomotive is 4 ft. 6⅜ in., the hight, exclusive of trolley, 3 ft. 2 in., and the length 12 ft. 6 inches.

The two locomotives, when coupled together, represent a powerful motor having a total weight available for adhesion of 52,000 lb., and a normal capacity equal to 300 h.p.

In winding shafts located near a breaker where the atmosphere is saturated with coal dust, the grease on the winding ropes collects the dust, and causes the ropes to become dry and gummy. Before examining such a cable, all the gummy grease should be removed; this can be done by applying coal oil to the rope.



VERTICALLY MOUNTED TRACTION REEL TO BE ATTACHED TO LOCOMOTIVE

The peat bogs of Germany cover nearly 11,583 square miles, while in Ireland the bogs cover one-tenth of the country. The depth of peat bogs usually varies from 5.4 to 7.6 yd., although Ireland has some bogs 16.3 yd. deep. It has been estimated that 1 square mile of bog 5.4 yd. deep contains 1,813,000 metric tons of dried peat.

The Origin of Coal

By H. M. Chance*

The zeal of the scientist seldom requires stimulation, but when a tonic is needed perhaps the most effective form in which it can be administered is as skepticism, for the fault finding of dissenters spurs the theorist to action as no other known force. It is with this thought and with the hope that by uncovering some of the absurdities and fallacies of the generally accepted theories of coal formation, impetus may be given to the elaboration of some more plausible theory, that this article is written. The writer has no new theory to advance, but desires to direct attention to some observed peculiarities of coal beds, and of the rocks with which they are associated, not satisfactorily explained by any heretofore proposed theories, in order to emphasize the inadequacy of such theories and clear the way for something better.

Are the Coals Vegetable Accumulations?

Referring first to coals of Carboniferous age, that is, to those lying between Devonian and Permian strata, the theory that they are vegetable accumulations of marsh or forest growths, requires the assumption of from 50 to 200 alternately subsiding and emerging oscillations, whereby the marshes or bogs or swamps were submerged and elevated above water-level. These oscillations are necessary to account for the different layers of the coal beds and their intercalary slate or bony partings, without taking into account those oscillations necessary for the accumulation of the material which now forms the intervening beds of slate, limestone, shale, sandstone, conglomerate and fireclay.

If this were the only argument to be offered in opposing this theory, it could be dismissed with scant consideration, for if one oscillation occurred during this period, there is no valid reason why we may not assume that five hundred or one thousand occurred; and in the absence of other objections the number and frequency of required oscillations could not be held to justify rejection of the theory, but as these and similar considerations constitute a connecting link in the chain of contradictory evidence, they cannot be ignored.

The fireclays underlying the coals have been the subject of much discussion, but without developing any satisfactory theory of origin. While these coals usually rest upon such a bed of clay, there are many exceptions to this rule, and these exceptions are most significant and may furnish a possible explanation of their origin or mode of deposition. In attempting to explain the origin of the underclays it has been assumed that they formed the soil which supported the vegetable growth from which the coal was made; this contention being supported by citations of the frequent occurrence of "roots" in the clay, while the character of the clay is explained by assuming that it was originally mud or clayey mud similar to that from which the shales and slates of the intervening measures were formed, and that the roots of the growing plants abstracted the alkalies and alkaline earths, converting them into a refractory clay.

This hypothesis, however, fails to explain why some of these fireclays contain nearly as much of the alkalies as the typical slates and shales, nor why the slate partings of coal beds were not likewise converted into fireclay, for they in turn must have formed the soil for the growth of vegetation from which the upper benches of the coals were formed. It is perhaps unnecessary to state that partings of typical slate from a fraction of an inch up to several inches in thickness occur in nearly all coals, have none of the characteristics of fireclay, nor do they show evidence of the presence of roots; while fireclay partings occur in some coals, they constitute an exception to the rule.

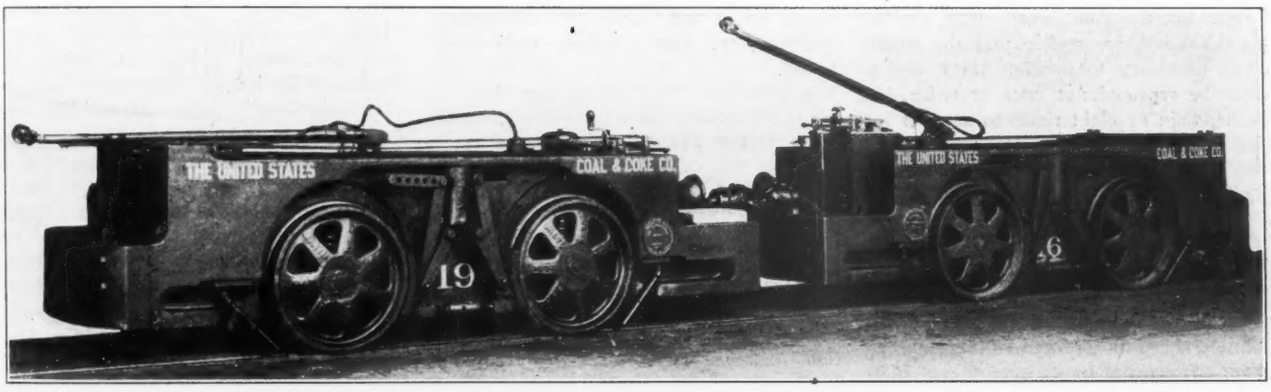
Again, it has been found that the different layers of a bed of fireclay may vary materially in composition; the top layer (that next to the coal) may contain as much iron and alkalies as a typical slate, the next layer may be quite low in iron and alkalies; the next underlying layer may contain a large percentage of these impurities, and the bottom layer may show a composition similar to that of the second layer. If these variations in composition be due to growing plants, it seems difficult to understand why the extractive power of the roots should vary so irregularly at different depths below the top of the soil in which they grew.

The Origin of Fireclay

If this theory be true, we should expect to find the soda, potash, lime, and iron extracted from the clay as a constituent part of the coal. In the case of a typical coal bed 4 ft. thick, carrying perhaps 8 per cent. of ash and resting upon a bed of fireclay 3 ft. thick, this theory requires that the plants from which the coal was formed have reduced the percentage of alkalies, from that of the slates (which may be taken at 4 per cent.) to that of fireclay (which may be assumed as 1 per cent.), involving the removal of about 13 lb. of alkalies from each square foot of the bed of clay. As each square foot of the overlying coal contains about 24 or 25 lb. of ash, this ash should contain about 50 per cent. of alkalies. It is, however, well known that the ash of most coals contains only a very small percentage of the alkalies.

If the coal flora was of such nature as to require for its normal growth, large quantities of the alkalies, then it would not flourish except upon such a soil; but here again our theory is contradicted by observation, for coal beds do not always become appreciably thinner where the underlying clay is replaced by sandstone, and it is quite improbable that the original sand beds contained a notable percentage of the alkalies.

It, therefore, may be as difficult plausibly to explain the origin of fireclay as of coal, and in attempting to do this it should be remembered that fireclays not



LOCOMOTIVES COUPLED TOGETHER AND USED AS A LEADING AND TRAILING UNIT

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overlaid by coal exist at many horizons in the coal measures, and extend over large areas.

When we attempt mentally to picture the possibility of a marsh, bog or forest that over scores or hundreds of square miles has produced sufficient vegetable matter to form a layer of coal a few inches or perhaps a foot thick, and which must have a top surface of such nature that a layer of mud or clay a fraction of an inch or a few inches thick, may be deposited upon it, without filtering down into the vegetable matter (such mud or clay ultimately making a slate parting a fraction of an inch or a few inches thick), and when we try to picture a further growth of vegetable matter accumulating upon this mud or clay sufficient to form several inches or feet of coal, without disturbing this layer of mud or clay, without filling it with a mass of roots or causing it to become mixed with the vegetable matter above or below, our ingenuity and imaginative powers are severely taxed. And when upon further consideration, we realize that the conditions necessary to produce these results must be repeated not once or twice, but perhaps six or eight times to account for the formation of a single typical coal bed 5 or 6 ft. thick, we may perhaps be justified in rejecting the theory as utterly improbable.

I desire to direct attention especially to the fact that the separation of a slate "parting" from the coal bench above or below it, is frequently defined by an absolutely sharp line, i.e., there is an abrupt change from coal to slate, pure coal is in immediate contact with pure slate, no transition layers being present either above or below the slate parting.

Transportation of the Sandstone

Until a plausible explanation is also found of the methods and agencies by which the sandstones and conglomerates were transported and deposited, we cannot hope to paint a true picture of the conditions existing during the formation of the coals. Reference may especially be made to the Mahoning sandstone and other similar rocks. The Mahoning sandstone is easily identified in Pennsylvania, Ohio, and West Virginia, over an area measuring about 250 miles east and west, and by an equal distance north and south, throughout which it is continuous and persistent, either as a coarse- or fine-grained sandstone, or as a coarse conglomerate of quartz pebbles ¼ to 1 or 2 inches in diameter, or occasionally as shale, shaly sandstone or sandy shale. It varies in thickness from about 20 to 100 ft. A few feet above it is the Upper Freeport coal bed (Bed *E*); within it, when split into two members, is a bed of coal, sometimes of workable thickness, and a few feet above it is the lowest persistent coal bed (usually quite thin) of the Middle Barren coal measures.

We do not know by what agencies the coarse sand and pebbles of which this rock are composed were transported and irregularly distributed over this area, nor from what source they were derived. The transportation of this material a distance of hundreds of miles from its source is difficult to explain, for the conditions of such transportation must of necessity not be incompatible with a long sequence of changes favorable to coal formation, followed by a long period in which similar conditions existed, but in which the coals were thinner and the sediments were fine muds or silts with some calcareous material.

If it be asserted that the quartz pebbles of this rock were transported hundreds of miles by rivers, we must assume hydraulic gradients for these streams and for their deltas which would leave along the course of their channels great boulder-filled cañons or valleys, which stretching for hundreds of miles through the coal measures and underlying formations, could not easily be overlooked; however, no such channels have been found.

Other Peculiar Conditions

While it seems unnecessary to present further evidence of the inadequacy of current theories of coal formation, if such be needed, attention may be directed to the frequent occurrence of limestones lying upon fireclay; to the carbonate of iron deposits; to the interesting lamination of some coals marked by minute layers of a material which (for want of a better name or perhaps because of ignorance of its true nature) is known as "mineral charcoal," or "mother-of-coal;" to the large quantity of pyrite in some coals; to the peculiar "rock-faults" which often have the appearance of stream channels eroded through the coal.

As the normal lignitic coals and lignites of Cretaceous and Tertiary age exhibit features similar to those already discussed, the same difficulties are experienced in attempting to explain their origin by current theories, and upon extending the discussion to certain abnormal coals found in the Mesozoic, Jurassic and at the base of the Cretaceous, further difficulties appear, especially in the case of some coals of rather extraordinary composition, which contain as much as from 7 to 9 per cent. of sulphur. The sulphur appears to be present in chemical combination with carbon or with some of the hydrocarbons. To explain the origin of such coals, it has been suggested that they are the remains of asphalt lakes, or of lakes of asphaltic oils. If this theory be true, some pertinent queries are immediately presented as to why these coals should be underlaid by beds of fireclay, and frequently should have an overlying slate roof, precisely similar to that of the normal coals of Carboniferous and Cretaceous age, and why the same, or a similar origin should not be assigned to all coal beds.

Crow's Nest Pass Coal Company

This company owns an extensive coal property in the Crow's Nest Pass district of British Columbia, operating coal mines and coke ovens at Fernie and Michel in that district. The report is for the year 1907. The capital stock at the close of the year was $3,716,280, having been increased by $216,280 during the year. Premiums received on new stock were $324,420, which amount was added to the reserve fund. That fund amounted to $2,124,420 at the close of the year.

The coal mined in 1907 was 981,939 tons, an increase of 175,038 tons over 1906. The coke made was 231,368 tons, an increase of 18,073 tons. The net profits for the year were $382,986, from which dividends of 10 per cent. were paid, amounting to $355,179; leaving a surplus of $27,807 for the year.

The president's report says: "But for a strike during April and the action of the smelters in raising wages, and so depriving us of our coke-oven men in midsummer, and then for the most part shutting down their mines and smelters for the last two months of the year because they could not operate under the new wage scale, the output would have overreached considerably the million-ton mark for the year.

"The costs of mining and coke-making during 1907 were increased greatly by reason of the advance in wages to miners, the irregular working of the men, the periodical scarcity of labor, the expense of securing new miners, the higher prices paid for all materials used, the heavy increase in freight rates, the larger cost of compensation for injuries to workmen and the extremely severe weather during the first three months of the year. Besides, a fluctuating demand for coal involved pressing the mines at times for tonnage, which had the inevitable influence of raising the cost. These conditions were the most unfavorable in the history of the company.

"During the year there has been spent on improvements the sum of $414,501 by the coal company; $21,735 by the Electric Light and Power Company, and $57,582 by the Morrissey, Fernie & Michel Railway Company (the last two being subsidiary companies of the coal company), or a total on improvements of $493,819.

"A new agreement between the company and its employees was reached on May 2, 1907, lasting until April 1, 1909. Increases in some of the mining rates, as well as to outside and inside labor, were accorded the men and a joint committee agreed upon to settle all disputes."

Is the Electric Current Safe in Coal Mines?

The Death Rate in Foreign Countries Has Been Reduced One-third as a Result of Investigations. Apparatus to Prevent Firedamp Ignition

BY RUSH N. HOSLER*

Electrical and mining engineers, as well as mine foremen and superintendents, while studying the practical adaptation of electric power to every kind of work, in and about the mines under their charge, have come face to face with one problem, which demands careful attention. It has been found that electrical-power transmission offers many advantages which no other power can furnish; but it must be acknowledged that electricity is also dangerous to some extent, in mines which give off explosive gases. The subject is broad, and one that has engaged the attention and best thought of the ablest scientists and practical mining men in every coal-producing country.

Coal mines may be divided into two classes, viz.: Those that do, and those that do not generate explosive gases. In treating these two classes of mines separately, I will first deal with electric power in non-gaseous mines. Notwithstanding the enactment and enforcement of laws defining the duties and responsibilities of persons engaged in work in and about the mines, we still find that accidents occur, and will continue to occur, as long as we mine coal. Such a thing as absolute safety is impossible; if absolute safety was to be attained we would have to stop all human activities. What we may call a safe agency, therefore, is a reasonable degree of safety, or accident reduced to its minimum.

The dangers resulting from the use of electric power in non-gaseous mines are as follows: (1) Shocks to men and animals; (2) fires caused by overheating of cables, resistances, motors, lamps, etc. Shocks may be received in many different ways, chiefly by coming in contact with uninsulated cables, or the opposite terminals of machines, or coming in contact with switches and parts of live machinery.

Some experts advise that we do not exceed a 300-volt current in our mines, claiming that a current above this may result in serious accidents to men and mules; the latter because of their shoes are most susceptible to shocks from a high-voltage current. I am inclined to believe, however, that any current above 100 volts may become dangerous; it is a well known fact, that a person having wet hands and wet feet, and standing on a rail or damp ground, can receive a worse shock from 100 or 150 volts, than a man can receive from a 500-volt circuit, when he has dry hands and feet and is on dry ground.

Guarding Against Electric Shocks

Most shocks that mules receive in the mines are largely due to carelessness on the part of some drivers and mule hustlers, who, trying to hurry at the end of a day's work, attempt to take the mules out alongside of an uninsulated wire, before the power is turned off. These shocks to mules may not always prove fatal, but often spoil a good animal.

To guard against shocks on motors, other than the totally inclosed types, all live parts should be netted or screened so that no one can receive a shock unless he first wilfully removes the protection. When installing electricity in mines we should guard against the high-current voltage and insist upon all machine terminals and switch fuses being provided with cover and these covers earthed and marked with white paint, so that there may be no doubt as to what they are for.

Electricity may cause fire in mines chiefly by: Motors overheating; heat caused by short-circuits; heat caused by bad connections; resistances becoming overheated; and from underground lighting systems.

The overheating of motors may arise from overload or some defect, but any real danger from this cause is not great; however, all inflammable material must be kept away from the machine, and it is best to have an ample supply of dry sand on hand. The circuit-breaker should be so adjusted that the motors cannot take enough current to overheat them to the danger point.

Short-circuits, in a properly installed plant, are liable to occur from defective design, bad insulation, something working loose, or some foreign substance coming in contact with parts of the machine.

Bad connections are things that should never exist, and do not exist around a plant that has been installed in a workmanlike manner and properly looked after.

Resistance must be kept well away from all woodwork, and if starting resistances only, they should be used with what is sometimes called a "fool-proof" switch, which will not allow the current to pass through the resistance after the motor has started up, unless the handle is deliberately held or tied in some improper way. A starting and regulating resistance should be so designed and proportioned that the full-load current will not overheat, then the machine-circuit breakers will take care of the rest.

Risks of fire from underground lighting can best be guarded against by careful and constant investigation and by using the best materials throughout the system. The most important points, however, are to keep all lamps away from timbering, coal dust and especially cobwebs, and use a low candle-power light; good materials and fireproof cable are essential. It is, therefore, evident, that electricity can be used for any purpose in non-gaseous mines, without any abnormal degree of danger, if the proper precautions are observed in the installation.

Use of Electric Power in Gaseous Mines

The prevention of ignition of mine gases from electric machinery has been made the subject of exhaustive experimental investigation in Great Britain, France and Germany. This subject was studied in Prussia by a special commission as long ago as 1885. In 1890 a series of investigations were made on behalf of the French government, and in quite recent years, in Belgium, in Germany, and in Great Britain, investigations, searching and exhaustive, have been made by eminent specialists. Both direct- and alternating-current motors, starters, resistances, switches, cables, transformers and every other part or parts of machinery that go to make up an electrically-equipped mine were subjected to tests under conditions as nearly as possible like those met in actual service.

In the year 1902 the British Parliament authorized the appointment of a committee of experts to inquire into the use of electricity in mines. On October 16, 1902, the warrant naming and authorizing the committee to proceed was issued. After their preliminary meetings and organization they assembled many times—extending from November, 1902, to May the following year—for the purpose of hearing witnesses and taking evidence. Among the various witnesses the following branches of the mining industries were represented:

1. Scientific experts, electrical engineers and manufacturers of electrical appliances.
2. Colliery owners and managers.
3. Miners' agents and miners.
4. Safety and electrical fusemakers, and representatives from insurance companies.

NOTE—Paper read before the Y. M. C. A. District Mining Institute, Philipsburg, Penn., May 7, 1908.

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Report of the British Experts

The committee not only examined witnesses and took evidence, but also visited collieries in every district in England and Wales, for the purpose of making personal observation and experiments. In prefacing my remarks on the dangers of electricity in gaseous mines, I desire to quote from the report of this British Royal Commission:

"It is obvious that if an agent so potent as electricity is installed with insufficient skill, and handled with carelessness or ignorance, accidents may result, but if properly set up and used, it presents, we think, no features of such danger as would justify its prohibition. Gunpowder and nitro-explosives are dangerous, and yet they have to be made and stored in magazines, and even boys under proper supervision, handle guns and rifles safely. Explosives in mines may not only cause accidents to those engaged in using them, but might cause explosions of firedamp unless properly handled, and yet it is not too much to say that they present features of danger greater than any that are likely to be found in electricity if properly employed. Steam under high pressure is capable of producing terrible explosions, and yet it has been used for a century without any abnormally dangerous results. Our recent experience of motor cars has shown the danger than may attend them, yet no one has proposed their prohibition, only regulation. To use an electric light in a mine at first sight appears dangerous, for if broken it may ignite firedamp. Yet it must be remembered that any miner's safety lamp if broken would set fire to gas with even greater certainty. Electric winding machinery may perhaps alarm those unaccustomed to its use, but on the Continent we have evidence that it is used for winding men and coal from the pit with steadiness and safety. Many more instances may be given of the successful use of dangerous materials—masses of molten metal are used at white heat; corrosive acids and chemicals are manufactured in large quantities. And when all these cases are considered, it is not too much to say that the well regulated use of electricity will, in the future, present far less dangers than many other industrial agencies. On the other hand, these powerful agencies may be made to play a most important part in diminishing the severity of human toil."

History, in Continental Europe, has in a remarkable way, confirmed the views thus expressed by the above mentioned committee, and the mines there, today, are using large, high-tension installations successfully without accident, owing to the strict observance of proper precautions. I believe that full latitude can be given to the great development of electrical machinery in mines, but desire to emphasize the opinion that those who are to use it, and be exposed to the dangers that may arise from it, have a right not only to expect, but demand that every reasonable precaution to secure their safety should be taken. There are risks in every occupation, and do what we may, mining, like seafaring and railroading, will always present dangers that are probably greater than those of other occupations.

The dangers from the use of electricity in gaseous mines are all those encountered in non-gaseous mines, and enumerated in the first part of our paper, and ignition of explosive mine gases by sparking and overheating. What I have said relative to shocks to men and animals, and concerning fire caused by overheating of motors, cables, etc., is likewise applicable in reference to gaseous mines, and, therefore, I will not discuss them further.

Sparking may occur during the normal working of machinery on the brushes of direct-current motors, and on making or breaking contacts on machinery and switches, also by the insulation on motors, cables and switch mountings breaking down, or it may be caused by cables being either broken in two or pulled out from their connections. In Prussia and Belgium, specially prepared galleries have been constructed to carry on a series of investigations with electrical apparatus in gaseous mines, and at a testing station at Gelsenkirchen, experiments were carried on for over a period of three years. The first year they confined themselves to examining the behavior of motors and other appliances submitted by various makers. The second year endeavors were made to ascertain the most suitable devices for preventing firedamp ignition caused by sparking in electrical appliances, and to test the various forms proposed; and finally, the third year was devoted to testing motors constructed in accordance with the experience gained in the first two years. The result of these extended experiments and investigations not only at the above named place, but in every other European coal-producing country, have established beyond doubt the following facts: First, that electrical apparatus in gaseous mines not only may cause, but has caused the ignition of explosive gases; second, that electrical apparatus can be rendered safe in gaseous mines, without undue complications and an abnormal degree of danger, at a reasonable cost.

At the above mentioned testing station, the following apparatus to prevent sparking and firedamp ignition caused by sparking, was thoroughly tested; hermetical casings, wire gauze protectors, labyrinth casing, cooling-tube attachments to casings, casings with flange ventilators, annular-grid casings and oil-bath casings. Of the different casings tried, the following proved the most satisfactory and we will give a brief description of each: 1. Hermetical casing. 2. Casings in which ventilation was secured by means of wire gauze. 3. Annular-grid casings. 4. Oil-bath casings.

There should be no division of the space inside of the casings into large compartments and connected by small openings. The surfaces of any parts of the casings and covers or manholes should take the form of large, smooth flanges, without any packing of rubber, asbestos, or other weak material. For hermetical casing, all parts should be strong enough to stand a pressure of eight atmospheres. No holes for relieving pressure are permissible.

For casings with wire gauze ventilation, the wire gauze should be preferably of the normal dimensions used for safety lamps, viz., of 1/75-in. wire and about 940 meshes to the square inch. The best material is bronze or galvanized steel wire, and the gauze must be uniformly made, clean and free from defects. The total protecting surfaces—the sum of several layers of gauze—should be at least 38 sq.in. per 100 cu.in. of internal air space. At least two layers of gauze should be provided, these being set not less than 1/5 in., and not more than 4/5 in. apart. Large surfaces of gauze should be strengthened by ribs. The gauze should be mounted on a detachable cover, facilitating the supervision and changing of the sheets. No soldering is permissible on the gauze, but the latter must be fastened in rigid frames, or tightly screwed in place by means of such frames. Perforated sheet metal, or other similar material should be placed over the gauze to protect it from external injury.

Annular-grid Casings

For casings with annular-grid ventilation, sheet-metal rings of bronze, brass or tinned, or galvanized steel are used, with a cross-surface of 2 in., and a thickness of 1/50 in. mounted, with spacing pieces so as to be not more than 1/50 in. apart. Leakage must be prevented so that the only communication between the interior of the casings and the outer air is through the annular grids. The number of the rings should be as large as possible in order to minimize the internal pressure, and should be attached to a detachable cover to facilitate inspection and changing. Some form of external protection should be provided for these ventilators.

Sufficient oil should be poured into the oil-bath casing to properly cover all sparking parts; the necessary depth of oil in the casing should be ascertained by the maker of the apparatus, and its level marked on the casing. The shape of the casing should be such as to preclude any exposure of the sparking parts, owing to violent motion of the oil.

The foregoing points indicate the features that should be aimed at in making the different styles of casing, in order to enable the system adopted to afford sufficient protection against ignition of firedamp. Other measures are also recommended as contributing to greater safety,

such as locking devices, which switch off the dangerous parts of the motor, etc., before the casing can be opened. The opening on the casings should also be sealed so that unauthorized persons cannot tamper with them. To prevent short-circuit sparking, no naked leads or terminals should be allowed outside the casing; the latter should be made very strong as a protection in the event of roof falls or the like. In actual workings, the casing must be kept in a proper state of efficiency, the wire gauze ventilators in particular needing supervision.

The gauze must be kept clean, and frequently examined for damage. With oil baths the depths of oil must be seen to at regular intervals, and suitable oil used. Insulation oil should be pure, unmixed mineral oil obtained by frictional distillation from petroleum, and not chemically treated, nor contain traces of either acid or alkali, and have a flash test not below 365 deg. F. Annular grids are free from any tendency to undergo injurious changes, but moisture and dust must be kept away as much as possible. The hermetical casing requires the smallest amount of attention.

With the use of these appliances, and the exercise of precaution, it seems that there is no longer any hindrance to utilizing the great advantages offered by the use of electricity in our mines, for the experiments, though tedious and ofttimes not free from dangers, have proved beyond doubt that electricity in gaseous mines can be used without any unreasonable degree of danger. One of the results of the British Royal Commission was the adoption of a code of rules, governing the installation and use of electricity in mines. These rules are now incorporated in the mining laws of Great Britain and are in force today.

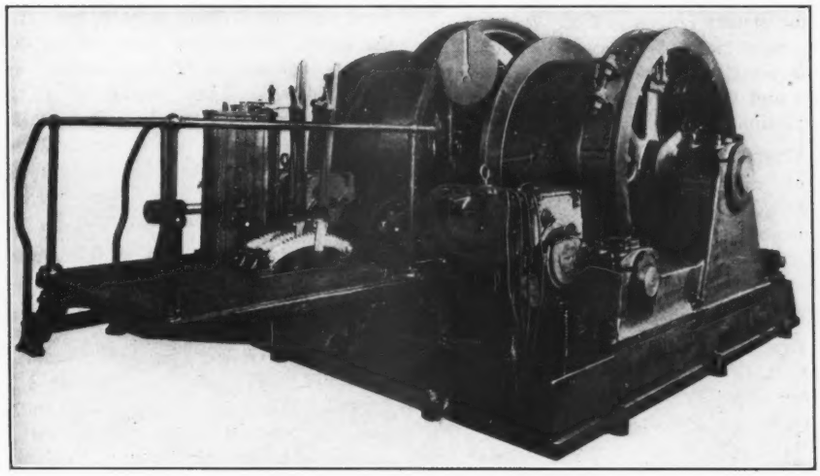
I firmly believe that an electrical inspector for mines should be appointed. His duty would be similar to that of our other inspectors, only his whole time should be given to the inspection of electrical machinery. He should examine all electrical equipment of mines as to their probable dangers of ignition of gases, and see that electrical plants were installed in strict conformity to the rules that should be recommended and adopted. This electrical inspector should be a skilled electrician, and have a broad and extended experience with actual conditions that exist in the mines, and should report direct to the chief of the department of mines.

The testing stations in Belgium alone, through their recommendations, led to a reduction in the loss of life from 3.19 to 1.02, or 2.17 men per each 1000 men employed. The rate per 1000 men employed in the United States for an average of five years (1902-1906) was 3.39, or more than three times what it was in Belgium during the same period; nearly 2.7 times greater than it was in Great Britain, and 3.72 times greater than the death rate in France.

A Novel Electric Hoist

The following description deals with a hoist that contains many novel features. The machine was built by the Vulcan Iron Works of Wilkes-Barre, Penn., and installed for the Hallidie Machinery Company of Seattle, Washington, who are the engineers for the Carbon Hill Coal Company.

The hoist is of the self-contained type driven by two No. 83 Westinghouse railway type motors, operating at 550 volts direct current, each motor having a capacity of 110 h.p., half hour rating. The motors are secured to the bed plate by the nose-spring suspension, thereby eliminating the shock occasioned by starting heavy loads. The motors are both mounted on a heavy steel shaft. Between the motors is the main driving pinion, the whole being mounted upon three babbitt-lined pedestals. The motors are controlled by a type R-6 controller with a separate reverse handle, eight points forward and eight reverse.



A NEW TYPE OF ELECTRIC HOIST, SPECIALLY ADAPTED FOR MINE WORK

Each drum has a capacity for winding 1500 ft. of 1⅛-in. wire rope in three layers, the rope pull being about 10,000 lb. at 600 ft. per min. At the end of each drum is secured an asbestos lagged brake ring, this type of brake being able to withstand the heat of heavy braking, and outlasts a number of sets of wood lagging. One drum is keyed direct and the other runs loose on a heavy open-hearth steel shaft. Between the drums is mounted the main spur gear, which as well as the drum is split in halves, and planed and secured with turned steel bolts driven in reamed holes.

The drum is carried on three babbitt-lined pedestals, which are cast integral with the bearings which support the motor shaft, thereby securing a perfect alinement of gears and shafts at all times. The loose drum is driven by means of a jaw clutch, which is operated by a hand lever on the motorman's platform. On this platform are also mounted the independent hand brakes of the band type, each brake being able to hold the load on any point of a 30-deg. slope.

All gearing is made of open-hearth cast steel with machine-cut teeth, and all covered with metal guards, as shown in the illustration. The bed plate is of rectangular box section, being made up of five pieces secured with turned-steel bolts. The connections between pedestals and bed plate are also made by turned-steel bolts and dowel pins.

The hoist is sectionalized throughout, so that it may be taken through a tunnel 6 ft. square. The machine is to be located in a damp chamber, which is limited to 16 ft. wide and 18 ft. long, with a maximum head room of 8 ft. The hoist is to operate continuously, or 24 hours per day, stopping only long enough to reverse between hoists. The location of the cars in the slope is clearly shown by a positive-dial indicator placed in front of the drums.

At Cerro Gordo, Cal., in a formation of slate overlying a compact, crystalline limestone, intersected by porphyries of various characters, veins of silver-lead ore occur in the limestone, or at the contact between the slate and limestone. The veins dip steeply. Their filling is quartzite, in which the ore is found in nests, pockets and irregularly shaped deposits. The ore was galena, anglesite and cerussite, large bunches of compact anglesite with a kernel of galena being a common occurrence, and was rich in both lead and silver. In 1874 the Union mine produced 12,171 tons of ore averaging 47 per cent. lead and 87 oz. silver per ton. With increasing depth, the galena ore predominated. The veins varied greatly in width, swelling out to 40 ft. in places and pinching almost to nothing in other places. The Union mine was the largest producer and for a while was worked very profitably.

Colliery Notes

In cases of accidental fires, collieries provided with rescue appliances are in a position to deal with the danger quickly and promptly and thus save thousands of dollars worth of property.

Changes made in the government mining regulations of Japan are considered extremely liberal, especially as regards foreigners. All mining machinery is to be admitted free of duty and the export duty on copper has been abandoned.

Locate a concrete mixer as near as possible to the place where the concrete is to be used; cement should be used as soon as possible after mixing, and should not receive too much handling or the mortar will separate from the coarser materials.

The velocity of the ventilating current at the working faces of a deep, dry coal mine should not exceed 300 ft. per min.; if the velocity of current is much over this limit, the mine air will become too dry and thus increase the danger of dust explosions.

While there is no doubt that blow-out shots are more likely to cause an explosion of coal dust under ordinary circumstances than a shot which does its work properly, it by no means follows that an ordinary shot is incapable of igniting coal dust.

A number of small valves give better results in a mine pump than does one large valve having the same area as the total area of the small valves; the smaller valves have a larger area of discharge and offer less obstruction to the pump discharge. They are also better adapted for work under great pressures.

The best method of cleaning hoisting ropes preparatory to an examination is to pass them through hot oil. Provide a V-shaped steel trough from 15 to 30 ft. long, with a steam space of 1¼ or 1½ in. around the bottom and sides. Fill this with oil, heat by means of the steam and pass the rope slowly through it.

In mine accidents where the patient is unconscious, lay him on his back or in the position where breathing is most easy; undo all tight clothing, around the neck, chest and waist. Give the victim the purest air available, raise his head somewhat if his face is flushed, but keep it low if the face is pale; give no stimulants by the mouth.

George Sullivan, an engineer at Baldwin mine, No. 4 of the Pittsburg Coal Company, though fatally scalded by the bursting of an 8-in. steam pipe, remained at the throttle of his engine until the cage containing 10 men was safely lowered 150 ft. to the bottom of the shaft. Many such acts of heroism have been accomplished by the men who produce our coal.

When putting down a drill hole, if it appears to be going crooked, it may sometimes be straightened by shortening the stroke or dulling the bit. If this is not effective, put a small piece of hardwood or iron in the hole, insert the drill and drill slowly; the drill will hit the hard substance and be deflected into line. In case this is not successful, the only remedy is to start a new hole.

In wet shafts, concrete makes a much better lining than wood, as the latter rots in a short time. Concrete for shaft linings should be made of portland cement and common boiler cinders; the strength and density of the mixture depends entirely upon the pressure to which it is to be subjected. Where the pressure is great, added strength may be gained by imbedding wire netting or twisted iron bars in the concrete lining.

Steam superheaters are important factors in ensuring economy. They are fixed near the fire and transfer heat from the gases, before they have passed over a large amount of heating surface, into steam, direct. They should be an integral part of a water-tube boiler, as they prevent wet steam when the boiler is worked under pressure, thus enabling an engine to do more work than it otherwise could accomplish.

Rock drills should be securely mounted. Where holes are drilled downward they should be kept partially filled with water; when holes are drilled upward, keep the drills dry for if wet drills are worked in dry holes, they will soon become dust-clogged. When cavities or seams in the rock are reached, work the bit with a short stroke until firm rock is again encountered. Holes which are to be drilled up should be started on a level if possible.

Creosoting of timber is done in the following manner: Place a quantity of wood in a large boiler, screw down the manhole door, extract all air from the boiler and pump creosote liquid into the boiler at a temperature of 120 deg. F. until a pressure of 100 lb. per sq.in. is reached. This liquid is obtained from coal tar and is made up of pitch, creosote, naptha and ammonia. The mixture enters into the heart of the wood and increases the life of the timber. Its one drawback is that it is inflammable.

The most efficient precautions to be taken to prevent gob fires in soft-coal mines have been found to be: (1), the exclusion of oxygen by closely built gate packs; (2) the keeping of a straight working face, and the avoidance of leaving ribs of coal or timber; (3) the clean stripping of all coal from the sides of a fault, which prevents grinding; (4) the removal of all débris; (5) the use of the panel system of mining which makes possible quick and complete isolation; (6) the use of the retreating system of mining, the gob being left behind; (7) the presence of a strong current of air in roadways and other places which show a tendency to heat.

Oil insulation for mine motors is regarded by many mining engineers as offering grave risks of fire; this fear is unfounded for no oil can possibly become a fuel unless heated to or above its flashing point, and this point is far above any temperative the switches, or even the transformers, should reach under ordinary conditions. No insulating oil should have a flash test of less than 365 deg. F., and the burning test should be at least 392 deg. F. It is unlikely that heat sufficient to raise the temperature of the oil to 360 deg. F. would ever occur. When heated to nearly the boiling point, oil should give off dense clouds of smoke; this is inconvenient and dangerous in a mine, and can be prevented by the use of a temperature indicator placed in the upper portion of the oil case.

Three compartment ventilating shafts of large area should be used for mines where the workings are extended. One compartment should be reserved for hoisting men in case of accident; the other two compartments should be used solely for ventilating purposes. Two moderate sized, reversible fans, independent of each other should be used with such a shaft and under such conditions. Each fan should ventilate independently its own portion of the mine. Place doors at the top and bottom of the shaft compartments so that if one fan has to suspend operations, by opening the doors a connection with the entire mine can be made and the work of ventilation can be carried on by the other fan. In cold weather this arrangement permits keeping wet shafts clear of ice, thus adding to the safety of the men and eliminating what is in many mines a difficult problem.

There should be a daily examination of all winding ropes by a competent person. A weekly examination is also advisable. The examiner should stand at the head of the shaft and the rope should be slowly raised or lowered through his hand, which should be protected by a thick glove or piece of waste; the rope should not move faster than 40 or 50 ft. per min. The observer should feel with his hand for broken wires and at the same time watch closely for other defects, such as excessive wear, loosening of the strands, straightening of the lay, kinking or severe corrosion. When anything abnormal is noticed, the rope should be stopped and the suspected portion thoroughly cleaned and examined. It is also advisable to watch the rope for a short time while it coils on the drum so that the position of possible punching or crushing can be located and examined. A monthly examination is also advisable as it allows the examiner to keep track of the normal wear of the rope and thus be in a position to calculate its remaining life and strength.

Mining and Transportation at Santa Eulalia

The Conditions Are Favorable, the Mines Are Dry, the Country Rock Requires Little Support and Labor Is Good and Not Expensive

BY CLAUDE T. RICE

The narrow-gage railroad, belonging to the Chihuahua Mining Company, reaches several of the mines both in the middle and western camps in the Santa Eulalia district, Chihuahua, Mexico. This road is 18 miles long and has a maximum curvature of 60 deg. and a maximum grade of 6 per cent. The difference of elevation between the mines and the lower terminal, Hacienda Robinson, is 1500 ft.; 22-ton locomotives are used and the ore is hauled in trains of 16 cars holding about four tons each.

gage branch, four miles long, which connects with the Mexican Central road at Alberto. This aërial tramway is composed of two parts with an angle station and bins between. The upper part between the Juarez and the Galdeana is a Leschen automatic-loading tramway, one mile long, while the lower tramway, four miles long, was made by the Trenton Iron Works. In the lower tramway there are three tension stations, while in the upper only one. On the loaded side the cable is 1⅞ in. diameter, while the cable on the

the Potosi, make only about 1000 gal. of water per day, and this is easily disposed of by bailing.

On account of the absence of water in the limestone (except in some large caves such as occasionally are cut in some of the mines), all water used in the district has to be pumped from Hacienda Robinson. This water is pumped by the Chihuahua Mining Company against a head of about 1500 ft. through a 4-in. pipe and delivered to the different mining companies. About 50,000 gal. per day are pumped.

SAN TOY TRAMWAY, LOWER PART, SANTA EULALIA IN THE DISTANCE

The Chihuahua company hauls its own ores and that of the Potosi Mining Company to the *hacienda*, while it hauls ore from the Buena Tierre and the Gasolina mines to Santa Eulalia where the ore is loaded into ordinary narrow-gage cars on the Mineral railroad and taken to the Mexican Central road at Chihuahua where it is loaded into standard-gage cars.

The Mina Vieja and several of the smaller properties pack their ore on mule-back to Santa Eulalia. But the San Toy has obtained a cheap transportation by building an aërial tramway system from its properties to the bins on its standard-

unloaded size is 1 in. diameter. Wooden towers are used for the upper tramway, while steel towers are used for the lower tramway. The tramway cost $120,000 (gold) erected. The cost of transportation over the aërial tramway exclusive of depreciation of plant, but including repairs, is about 21c. per ton.

Water

The limestone is quite free from water so that the mines are not troubled with pumping; in fact, there is not a single mine pump in this district. The two deepest mines, the Santo Domingo and

Hoisting

The largest hoist in the district is that at the Potosi No. 1 shaft. This is an Allis-Chalmers first-motion hoist having a conical drum, the large diameter of which is 13.5 ft. and the small diameter 8.5 ft. The Mina Vieja and the Velardeña mines are equipped with geared electric hoists which are to be run from a dynamo at the Gasolina mine. The smaller mines use Fairbanks-Morse gasolene hoists, there being more than 25 of these in the district. On account of greater portability of the fuel and the

small amount of water required by gasolene engines, these are well adapted to the requirements of the small shafts in this district.

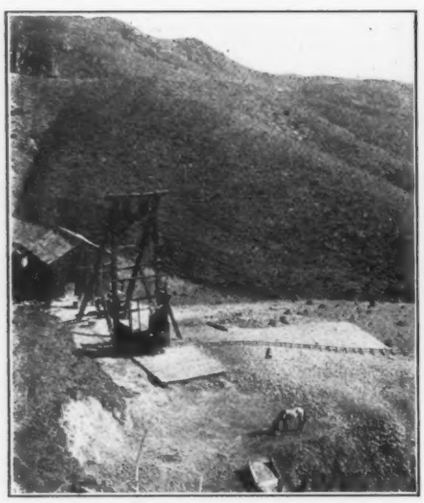
Shafts

The deepest shaft in the district is the Santo Domingo, which is 1850 ft. deep. The Potosi No. 1 and No. 2 are both 1700 ft. deep, and the Buena Tierra and the Gasolina shafts are 1400 ft. deep.

The Santo Domingo and Potosi No. 1 shafts have three compartments while most of the others have two compartments. The Gasolina, the San Antonio and the Mina Vieja (the old shaft) probably have the smallest two-compartment shafts in the world. These shafts are the same size, 3 ft. 4 in. by 5½ ft. in the clear, and were all sunk by the same man for working shafts. Skips are used in these shafts so that a considerable tonnage of ore can be hoisted. The Buena Tierra 5x15-ft. shaft by hand is about $15, the contractors doing the timbering and furnishing all supplies except timbers. To sink the Juarez two-compartment shaft, 5x9 ft., by day's pay, it costs about $40 per meter, or $12.50 per ft. To sink the Potosi No. 2 two-compartment shaft, 5x10 ft. in size, which was sunk by machine, cost, including hoisting, timbering, timbers and all supplies, about $30 per foot.

The cost of driving a drift 6x6.5 ft., either by hand or with machines, is about $9 per ft., the contractor furnishing everything but the drills, and, if machines are used, the power. The cost of driving 1½-compartment raises is about the same.

The cost of mining I do not know; but much of the ore is mined on contract at 25c. per 14-cu.ft. car delivered at the shaft, the company furnishing drills, and if machines are used, power. This price applies only to the softest ores in which only a pick is required to loosen the ore. In other cases the ore is hard enough to require machines, and then, of course, the cost is many times as great.



EL CRISTO MINE

MEXICAN VILLAGE, SANTO DOMINGO MINE

also uses skips which hold about 1½ tons.

The Potosi No. 1 and the Buena Tierra shafts are equipped with steel headframes; all the other shafts are equipped with wooden headframes. All the mines but the Santo Domingo use round rope; at that shaft flat ropes are used. Most of the mines use crossheads with the buckets, the ore from cars being dumped into pockets and loaded from the pockets into the buckets.

Breaking Ground

Most of the shaft sinking in the camp is done by hand and on contract, but some of the hand-sinking is by day's pay; in a few cases machines have been used. The shafts seldom require any support to hold the walls, and timbers are used only to hold the guides for the cages or the crossheads. Except where the rock is broken up slightly no lagging is used in the shafts.

The price paid per foot for sinking a

Wages

All men work 9-hr. shifts except the firemen and hoisting engineers, some of whom work 8 hours and some 12 hours. The wages in *pesos* are as follows: Men handling waste or packing ore up ladders (*peon* labor), $1.75-$2 per day; dry-waller (*trinchercro*), $2-$2.25; carman (*carrero*), $2; miner (*barratero*), $2; trackman and timberman (*palero*), $3; machineman (*perforista*), $4; machineman's helper (*ayudante*), $2.50; topman (*contra*), $2.25-$2.50; hoisting engineer (*palanquero*), on first motion hoist, $6, on geared hoist, $4; fireman (*fogonero*), $2.25; skipman or man loading buckets at ore-pocket (*mantero*), $2-$2.25; nipper (*sora*), $1.50-$2; blacksmith (*herrero*), $2.50-$3.50; helper (*ayudante*), $2-$2.25; carpenter (*carpintero*), $3-$3.50 without tools, with tools, $4; shift boss (*poblador*), $3-$3.50; foreman (*maestro minero*), $5-$7; American foreman, $5 to $7 (gold).

Most of the companies have an American foreman, but the Chihuahua and Potosi mining companies, which are run by the same management have a Mexican general foreman all day-shift, under whom is a Mexican foreman and shift bosses on each shift. In fact at the mines under that management the superintendent, the assistant superintendent, the bookkeeper, the train master, the master mechanic and the timekeeper are the only Americans employed, all the others being Mexicans. Some of the companies employ American assayers; but others have Mexicans who are good at making fire-assays and for analyses for lead, zinc, iron and silica, but are not technical chemists.

The Mexicans are good miners in northern Mexico. Some of them are almost, if not quite, as good machinemen and timbermen as similar men in the United States. By selecting these it is possible to organize a good crew of men. The Mexican in Chihuahua is a good man with the single-jack, he has a fine nose for ore, is a good shoveler and when necessary will work in places where a white man would not, especially in places where the ore has to be packed out on the back. This is an advantage in prospecting work in irregular deposits like those at Santa Eulalia. The trouble with the Mexican is that he will "soldier," and it is always best to do as much work as possible on contract. As dry-wallers they are especially good, for the dry walls in the Santa Eulalia mines are some of the best, if not the best, that I have ever seen; but, of course, the flat pieces into which the limestone breaks are especially favorable for dry-walling.

The Mexican bosses are apt to stand in with their men if not watched; therefore, there must be one man about the mine who has had considerable practical experience so as to guard against this. If

the superintendent is not a good miner himself then he should have a white foreman; otherwise a Mexican foreman is possibly cheaper.

It is well to provide houses for the miners so as to have them living near the mine, for thus a more permanent class of workmen is obtained than if they are encouraged to live in town. The Chihuahua and Potosi companies are the only large companies to provide dwellings for their Mexican miners, but they are repaid by the fact that many of the miners have worked for the company six or seven years.

In Chihuahua the mining companies are not troubled by many *fiestas;* in fact at Santa Eulalia only about seven holidays are lost in the year.

Prospecting

In prospecting in this district there is little to aid the work except that it is known that the orebodies occur usually along northerly and southerly fissures. The presence of limestone stained with iron and manganese oxides is a good indication of the vicinity of the ore, but even that is not a sure sign.

Owing to the fact that the mineralization does not extend into the surrounding limestone, it is quite possible to pass near an orebody without striking it. The vicinity of *antiguas* is a good place to prospect; in fact with the possible exception of the Potosi mine, discovered in 1902, all the deposits have been found near *antiguas.*

Mining Methods

Drilling is done either by hand or machine. Two Mexicans are used on a 2¼-in. air drill. The Potosi Mining Company is using two Waugh air-hammer drills and these are doing excellent work. This company has been using these two drills over three months, and not a cent has been required for repairs although the drills were run two shifts a day by Mexicans.

While machines are used in mining, much of the ore is so soft that a stick of powder would loosen tons of material. Consequently in many stopes most of the ore is mined by pick and shovel.

The old Mexicans followed the ore wherever it went, packing it out generally on their backs but sometimes using cars and even taking burros right into the stopes, the acme of Mexican mining. At first one may scorn the Mexican's methods of mining but a short time spent in the old stopes soon tempers the scorn with admiration. In view of the amount of ore that the Mexicans have mined from Santa Eulalia one cannot help respecting the way that they have followed these irregular deposits.

The American should not despise the Mexican method of packing ore out on his back when prospecting such irregular orebodies as those at Santa Eulalia. To mine them probably the best method consists in following the ore upward until the roof of the ore deposit is reached. Then the roof is picked and barred down or if necessary slabs are blasted down until a roof of solid limestone is obtained. Underhand stoping is then begun, the ore being blasted into the raises put up in the orebody. By this method large stopes over 300 ft. wide and 215 ft. high have been mined without timbers and without accident, for the limestone is very strong and does not air-slack.

The ore is generally too weak for successful overhand stoping; that method was tried at the Santo Domingo and resulted in a large cave; at the Mina Vieja the method was abandoned on account of the high cost of timbering. The drawback of underhand stoping is the disposal of the waste; in case the orebody is not too vertical and especially if there are many *mantas* this can be piled in the stope. Otherwise a drift can be driven near the top of the orebody and the waste which occurs mainly on top of the ore can be trammed to a neighboring stope along the fissure and used for filling.

Disposal of the Ore

The Santa Eulalia ore is smelted crude, the only exception being that some of the heavy lead ore from the San Antonio mine is concentrated in jigs. The ore is sent to the smeltery at Torreon, belonging to the Compañia Metallurgica de Torreon, to El Paso, Aguas Calientes and to Monterey to the American Smelting and Refining Company. Several months ago the American Smelting and Refining Company completed a 500-ton smelter at Chihuahua, but as yet it has not been blown in. The coal and coke bins have been filled for some time, and now the company is shipping ore from its Santa Eulalia mines to this smeltery so that possibly before long the works may be running. At least it has served the purpose of keeping out, for the present, an independent smeltery. But it is hoped that some large independent smelting works will be built which will use the Santa Eulalia district as its source of lead ore. Such a project is feasible for much of the ore is mined by companies not over friendly to the American Smelting and Refining Company.

The output of the camp is at present about 900 tons of ore per day, but this is far below normal. The Potosi and Chihuahua Mining companies, the largest producers, are said to ship about 350 tons per day from the Galdeana and Juarez mines. The American Smelting and Refining Company is producing about 225 tons of ore per day, from the Gasolina, Mina Vieja, and San Antonio mines; while the Santa Eulalia Exploration Company is producing about 125 tons per day from the Buena Tierra mine.

The Santa Juliana, the San Antonio and Las Tres Mercedes also are producing small quantities of ore, as is also the Cristo mine.

AUTOMATIC LOADING STATION, JUAREZ MINE

ANGLE STATION, GALDEANA MINE

Conclusions

Santa Eulalia promises to be of far more importance than it possesses at present; in fact it appears as though the camp has hardly begun to produce, although its records show a long and honorable past. At present there is too much of a tendency in most of the mines to mine the ore as fast as it is developed.

The finding of the mixed sulphide ores only at great depth is promising and the persistency of the Santo Domingo and

Potosi deposits should encourage the other companies in the district if they needed any encouragement. The depth of the limestone is unknown but nowhere in the vicinity is the base of the limestone shown so that it is safe to infer that this limestone extends considerably below the deepest workings. Already a thickness of about 2000 ft. of limestone has been shown in the district.

In conclusion I wish to thank B. L. Farrar, general superintendent of the Chihuahua and Potosi Mining companies and Donald Gillies, president of the San Toy Mining Company for the many kindnesses which they have shown me. I wish also to acknowledge the aid that I have received from the valuable compilation of papers gathered together by Jorge Griggs and entitled "Mines of Chihuahua".

In these articles no attempt has been made to describe the camp thoroughly but only to give the reader an idea of the ore occurrence. Therefore many promising properties have been no more than merely mentioned.

Testing Galvanized Iron

By Sherard Cowper-Coles*

It is a matter of considerable importance to engineers who use galvanized iron to know the amount of zinc that is applied per square foot of the surface. The thickness of zinc has hitherto been determined almost universally by the copper-sulphate test, known as Preece's test, which consists in placing the galvanized iron in a saturated solution of copper sulphate for one minute and continuing the immersions until it shows a red deposit of copper, which is a true indication that the zinc has been penetrated and the iron exposed. This test, when carefully carried out, is fairly reliable as regards hot-galvanized iron, but it is found quite useless for the more recent forms of galvanizing which are now being extensively used, i.e., electro-galvanizing and Sherardizing, for the following reasons:

On applying Preece's test to Sherardized and hot-galvanized articles coated with an equal thickness of zinc, the former require from three to four times the number of immersions which suffice to remove the zinc from the latter. When hot-galvanized articles are placed in a saturated solution of copper sulphate the copper is precipitated in a loose form, but when Sherardized, Cowperized or electro-zinced articles are similarly treated the copper adheres firmly to the zinc and no fresh surface is exposed, apparently, because the deposit of zinc applied by these processes has a fine matted surface.

The Ferric Sulphate Test

It would appear from these observations that the apparently great resistance to corrosion of Sherardized iron when subjected to Preece's test is due to the protection of the zinc by the deposited copper; so experiments were made with a solution of ferric sulphate, which dissolves zinc without forming a precipitate on the zinc coating. To test this, known areas of Sherardized and hot-galvanized plate were exposed to the action of ferric-sulphate solution for an equal period and the amount of ferrous salt formed by the reducing action of the zinc determined. The accompanying table shows the relative corrosion:

ZINC DISSOLVED IN FERRIC-SULPHATE SOLUTION.

No.	Sample.	Zinc per sq.ft., grams.	Zinc Dissolved, grams.
1.	Sherardized	26.908	0.080
2.	Sherardized	26.908	0.074
3.	Sherardized	22.93	0.057
4.	Hot-galvanized	22.12	0.058
5.	Sherardized	31.116	0.034

Sample No. 2 was moistened with water and allowed to dry; the oxide formed appears to protect the zinc and this protection is more marked if water is allowed to act for a longer period than was permissible in these experiments. It will be noticed that samples Nos. 1 and 2, which had a thicker coating than samples Nos. 3 and 4, dissolved to a greater extent than samples Nos. 3 and 4, which had practically the same weight of coating dissolved; sample No. 5 was Sherardized copper and, although the zinc coating was the heaviest yet the corrosion was in this case the least, probably due to the conversion of the greater portion of the zinc into brass. On testing this sample with copper-sulphate solution, as in the other cases, instead of a brown precipitate of copper a bright metallic deposit was obtained and no further action seemed to occur.

From the results of experiments, the copper-sulphate test has been found to be quite unsuitable for testing electro-zinced, Sherardized, or Cowperized surfaces; therefore, in future it will be necessary to substitute some other test, such as the ferric-sulphate test, or a modification of the copper-sulphate test.

*Metallurgical engineer, London, England.

Lake Creek, Wyoming, a New Mining District

By Wm. Benton*

Lake Creek, the new mining camp opened in Wyoming during the last year, is not in an unknown part of the State. It is traversed by a public road used by prospectors and freighters for the last 25 years. Very little prospecting would have disclosed large boulders of copper ore and many showings of visible gold especially on Joe Davis hill. In the northwest corner of the district is Lake mountain, rising several hundred feet above the surrounding country. This mountain is a core of basic rock; from this core to the southwest the rocks become more acidic, the region being intersected by numerous dikes and fissures. The most promising orebodies thus far discovered have been found at the intersection of these dikes and fissures. The ore carries gold in sulphides of iron and copper; the gold does not appear in the gangue.

The chief mineral belt is about two miles long, extending along Lake creek which drains the district. The principal mines in this part of the district are the Pollyton, Madem, Joe Davis, Joe Davis No. 3, Kansas, Kansas No. 2, Lake Creek, Lake Creek No. 2, Extension, and at the two ends, the Osceola and the Nugget.

The Madem claim is considered the best in camp. It has an adit 750 ft. long in which two distinct ore shoots have been discovered. The orebodies are several feet wide and 40 to 50 ft. long, yielding ore which after some sorting assays about $50 per ton. The breast is more than 200 ft. below the apex of the vein, and within 200 ft. it should cut a vein of gold ore opened at the surface by a shaft 12 ft. deep from which 60 sacks of ore were obtained averaging $30 per ton.

From the portal of the Madem tunnel 1000 ft. northwest is the Pollyton property on which a shaft now 25 ft. deep has been in ore all the way from the surface. The vein has been opened up for more than 100 ft. along the strike, and at all openings ore is found. This vein is opened several hundred feet farther west on the Osceola property, by a 50-ft. shaft showing the same class of ore and gangue material with somewhat more gold.

About one mile to the east of this zone is another zone, which promises large bodies of ore. The best known properties in this vicinity, are the Lake Creek claims, Nos. 2, 3, 4. Here a large replacement vein of quartz in porphyritic-diorite will produce good milling ore with perhaps some high-grade ore. In the southern part of this zone is situated the Kansas group. In a 50-ft. shaft and 40-ft. tunnel an ore shoot 7 ft. wide and more than 100 ft. long is shown. The copper is leached out of the ore thus far reached but sulphides of copper and iron, similar to the ores in other properties surrounding it are expected to be found lower down.

The Quartzite and Cora-Iva groups are situated in the southwest part of the district. Here large veins of quartz in schist will produce a good grade of milling ore, the surface showing being unusually extensive.

Along the west of this district flows Douglas creek, which has the richest placer mines in the State. A leasing company controls 2500 acres of the ground and is carrying on extensive dredging operations. The placer gravel is reported to average 30c. per cubic yard.

*Lake Creek, Idaho.

The Cost of Producing Copper in Arizona

The Low Cost Per Pound in the Four Chief Districts Is Due to Richness of Ore Rather Than to Favorable Conditions

BY JAMES RALPH FINLAY*

In 1907 Arizona became the leading producer of copper in the United States. Unlike Michigan and Montana, each of which has but a single district, Arizona contains the four important and distinct districts of Bisbee, Globe, Clifton and Jerome, all differing markedly in character and, therefore, in costs.

The external factors are uniform and unfavorable. The situation of the mines in an arid plateau poorly supplied with water, fuel, timber and population, with freight rates inevitably high, makes for high costs. Wages of white miners are $3.50 a shift of eight hours; Mexicans are paid $2.50 a shift. The summer heats are debilitating and the energy of the men is somewhat less than it would be farther north. This is true particularly in regard to metallurgical work.

SUMMARY OF OPERATIONS, ARIZONA COPPER COMPANY.

	1904.		1905.		1906.	
Total ore (tons)	491,600		547,000		610,000	
Total copper (lb.)	28,732,800		30,080,000		29,756,000	
First-class ore (tons)	31,695		26,000		31,378	
Concentrating ore (tons)	460,000		521,000		578,517	
Copper per ton (lb.)	57.5		56.3		48.8	
Tons smelted	102,893		108,000		121,507	
Tons leached	80,100		90,000		80,000	
Copper from leaching (lb.)	2,824,000		2,470,000		2,126,000	
Copper per ton from leaching (lb.)	35.3		26.3		26.7	
		Per Ton.		Per Ton.		Per Ton
Cost working mines (deadwork, ores purchased, leaching, etc	285,056	$2.81	276,326	$2.46	373,560	$2.50
Smelting, refining and marketing	194,077	1.90	215,846	1.93	258,506	2.06
General	14,286	0.14	14,430	0.13	15,579	0.14
Interest and amortization	49,162	0.49	58,965	0.52	88,765	0.70
		$5.34		$5.04		$5.40
Cost per lb. at New York		9.3c.		8.93c.		11.07c.

The internal factors vary with each district. These will be described separately.

Clifton-Morenci District

The Clifton-Morenci district produces porphyry ore in which chalcocite is disseminated. In this respect the orebodies resemble the deposits of Bingham, Utah, and of Ely, Nev. The ores form large irregular bodies at depths of from 100 to 300 ft. below the surface. In this respect the ore is easy to mine. But there is a certain irregularity, not only in the orebodies as a whole, but also in their internal make-up. A certain amount of sorting may be done to advantage in the mines. The ore is fairly hard and firm and is taken out by square-setting. Mexican miners with white bosses are employed.

Costs are not generally stated in detail, but the reports of the Shannon and Arizona copper companies make plain the following facts:

*Mining engineer, New York City.

About 1 ft. of opening work is necessary to find and develop 15 tons of ore. The cost of this work is stated to be 21 to 33c. a ton (Shannon). Stoping costs are about $2 to $2.80 a ton. Details for one year are shown in an accompanying table.

The Arizona Copper Company gives its costs for mining, including deadwork, ores purchased, and leaching, as follows: 1904, $2.81; 1905, $2.46; 1906, $2.50. It seems fair to assume from this that the underground costs are substantially the same as the Shannon. The same may be said of the Detroit Copper Company.

Assuming that the cost of mining, including development, is $2.25 to $2.50 a ton, and that out of this cost about 50c. is due to timbering, it seems fair to say

SHANNON COPPER COMPANY, MINING COSTS, 1904-5.

	Total Cost.	Cost Per Ton.
Assaying and sampling	$ 9,226.70	$0.048
Executive and office expense	10,519.33	0.055
Taxes, insurance and hospital	3,251.33	0.017
Incline	6,099.33	0.032
Extraction	176,124.71	0.932
Timbering and framing	94,769.75	0.501
Filing	10,749.47	0.056
Tramming	21,234.72	0.112
Tracklaying	9,193.13	0.048
Handling supplies	8,411.72	0.044
Miscellaneous	13,032.10	0.069
Total operating expense	$362,662.29	$1.92
Development	23,600.68	0.124
Exploration	17,609.68	0.093
Total mining cost	$403,872.65	$2.138

Ore received, 188,856 tons.

that the excess over Lake Superior costs is due to the external factors.

The internal factors that govern the cost of treatment are the losses due to concentrating, the proportion of concentrates to the crude ore and the smelting qualities of the ore.

(1) The Shannon Copper Company reports for 1904 a saving of 75 per cent. on ore averaging 4.16 per cent.; in 1905, 73 per cent. on ore running 3.77 per cent., and in 1906, 69 per cent. on ore averaging 3.36 per cent. This saving is for both smelting and concentrating.

(2) The Shannon Copper Company smelted in 1905, 44 per cent. of its total output; in 1906, 44½ per cent.; in 1907, 56 per cent. The Arizona Copper Company smelted in 1904, 22 per cent. of its total output; in 1905, 20 per cent.; in 1906, 20 per cent.

The costs for concentrating, smelting, refining and marketing are not given in detail, but in the case of the Arizona Copper Company these costs lumped together were, in 1904, $1.90; in 1905, $1.93; in 1906, $2.06, the costs being based on the entire tonnage sent from the mine. If the cost of concentrating is 75c. a ton, including transportation from the mines, the cost for smelting, refining and marketing would appear to be about $6 per ton smelted. On this basis the cost to the Shannon company, on account of the larger proportion smelted, should be $1.80 higher than to the Arizona company. This seems to be approximately the case.

(3) Certain difficulties have been experienced in smelting on account of a deficiency of sulphur for matting purposes. This is particularly the case with the first-class ores. In the earlier days this difficulty added more to the cost than it does at present.

SUMMARY OF OPERATIONS, SHANNON COPPER COMPANY.

	1903-4.	1904-5.	1905-6.	1906-7.
Smelting ore (tons)	66,005	53,340	69,342	
Mill ore (tons)	91,311	135,503	140,683	
Total	157,316	188,843	210,026	209,654
Per cent. copper, smelted ore	5.28	4.70	4.37	
Per cent. copper, mill	3.34	3.41	2.86	
Per cent. copper, average	4.16	3.77	3.36	
Copper, lb. saved per ton	62.34	55.03	46.41	47.6
Per cent. saving	75.0	73.0	69.0	
Feet development	11,931	14,740	14,610	
	Cost Per Ton.	Cost Per Ton.	Cost Per Ton.	
Operating mines, mills and smelters	$6.04	$6.91	$6.20	
Exploration & development	0.21	0.30	0.33	
Freight, refining, etc	0.90	0.70	0.65	
General expense	0.39	0.28	0.30	
	7.54	8.19	7.48	
Outside developments, etc.	1.08	0.75	0.70	
Total	$8.62	$8.94	$8.18	
Cost per lb. at New York	13.7c.	17.6c.	15.7c	

Stoping cost per ton $1.92.

Bisbee District

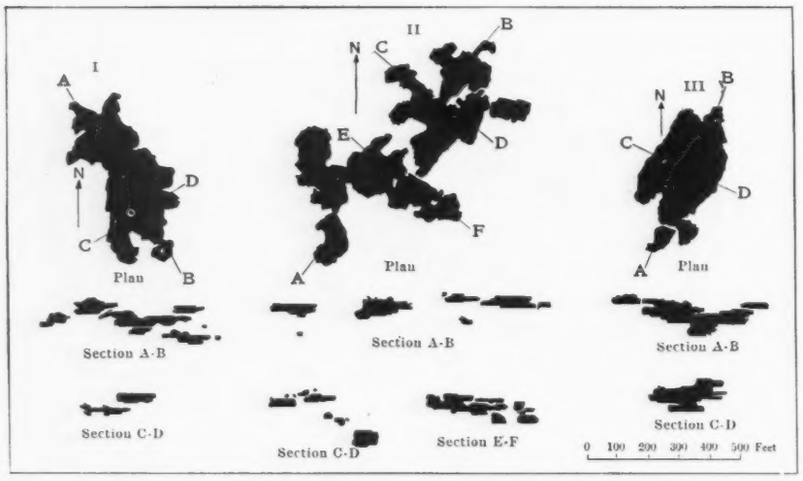
In the Bisbee, or Warren, district, the internal conditions are essentially different from those of Clifton. This fact is

sufficiently reflected by the mining costs which are at Bisbee $6 a ton against $2.50 or less at Clifton. Dr. James Douglas describes the Copper Queen mine in a paper in Vol. XXIX, 1899, *Transactions* of the A. I. M. E. The ore yielded, "about 7 per. cent. copper after a rough selection in the stopes where about one-half the total material broken is rejected. To supplement the deficiency in filling the stopes, barren ledge matter from exploratory drifts is used. Though the timbering of worked-out portions of the mine is thus enforced, so violent is the movement of the ground that the timbers are dislocated or crushed to chips. About 30 ft. board measure of timber (from Puget Sound) is buried in the mine to the ton of ore extracted." This is a terrific cost for timber, at an average price of $24 per M. delivered at the mine. We have on this basis 75c. a ton for timber alone. From 7 to 10 tons of ore are extracted per foot of opening work. A large part of the exploratory openings have to be closely timbered, and the cost for this work is high.

impossible to determine their actual size, but approximately there has been exposed above the 400-ft. level not less than 10,000,000 tons of ledge matter." Since at the time this was written not much over 1,000,000 tons of ore had been mined above the 400-ft. level, it is probable that Dr. Douglas believes that the ores now occupy approximately one-tenth of their original volume; the remaining nine-tenths being now "ledge matter," mainly ferruginous clay.

Nothing could be clearer than the above description as an explanation of the cost factors. All the altered residual masses must be explored; this means that the mine development, in addition to the shafts and drifts necessary to reach the ore, must search through 10 cu.ft. of difficult mining ground for every cubic foot to be extracted.

At various places in the mines large masses, like kernels, of original pyrites still exist, surrounded on all sides by the "ledge matter." Although workable ore is found along the periphery of these



PLANS AND SECTIONS OF STOPES IN THE COPPER QUEEN MINE. FROM BULLETIN 21, U. S. GEOLOGICAL SURVEY, BY F. L. RANSOME

The reason for the conditions described will appear very plainly from a consideration of the structural relations of the orebodies. Dr. Douglas says: "With regard to ledge matter and the oxidized ore, my own opinion is that they are the product of replacement and local concentration; that where there is ledge matter today there was, originally, more or less compact iron pyrites carrying a small percentage of copper; and that during the process of alteration not only did the ferruginous solutions of alumina replace the pyrites, but the copper, by a process of segregation akin to crystallization, was concentrated and collected into areas of limited size, thus constituting the comparatively small bodies of oxidized ores which are disseminated irregularly through the very large masses of ledge matter. As the outline of the masses of ledge matter has never been traced, it is masses, the pyrite itself is not payable. No concentrating ore has yet been found in the district. All the ore raised from the mines must be smelted, consequently it must be selected as much as possible.

To sum up—there are in these mines three powerful factors that make for high costs: (1) A very large proportion of development work; (2) soft ground, requiring slow, cautious working and heavy timbering; (3) careful selection imposed by the necessity of smelting the whole product, thus imposing a high subsequent metallurgical cost. This is the most imperative factor of all, for it can be shown that in this case lower costs at the expense of lower-grade ores might result in frightful losses. To mine 4-per cent. ore for $3 a ton against 7-per cent. ore at $6 a ton, smelting costs remaining the same, would increase the cost of copper about 0.82c. a lb., or $16.40 a ton.

The Copper Queen mine, unfortunately, does not publish its reports, and the Calumet & Arizona, the only other important mine at Bisbee, does not give details. The figures from the Calumet & Arizona reports in an accompanying table throw some light on the subject.

OPERATIONS AND PRODUCTION, CALUMET & ARIZONA MINING COMPANY.

	Tons Ore.	Tons Copper.	Price, Cents per Lb.	Feet Development Work.
1904....	205,807	15,819	12.562	27,485
1905....	202,952	15,886	14.982	25,577
1906....	236,565	18,735	17.96	14,818
	645,324	50,440		67,880

		Copper.	Silver, etc.
Value of product....	1904	$3,974,454	$195,926
	1905	4,744,328	178,843
	1906	6,725,663	238,464

Tons ore per foot of development work, 9.5.
Cost of copper in New York, 7.76c. per pound.

These figures include all construction work, of which there was considerable. The costs may be divided almost equally: Mining per ton of ore, $6.06; smelting, refining and marketing, $6.05; total, $12.11 per ton of wet ore.

Mining on the California Desert

SPECIAL CORRESPONDENCE

The desert mining sections in the southern portion of California are receiving considerable attention these days, and a great deal of development is taking place at many points. In the Coolgardie district, 20 miles north of Barstow, San Bernardino county, Henry Mountain, of New York, and others are shipping in dry washing and concentrating machinery for placer mining. Placer gold has been found there for many years, but it has been difficult to work the ground profitably. It is hoped that this new machinery will solve the problem. Rich gold strikes have recently been made near Wingate Pass in the Hidden Springs region of the same county, and a rush to the new field has set in. The ore is free gold, but little development has been done. The new field may be reached by wagon road from Panamint, or by way of either Daggett or Barstow. Twenty Nine Palms district in the same county is now attracting some attention. Virginia Dale district lies east, Piñon on the south and Morongo district on the west. A number of old arrastras have been found, which were doubtless used before California became a State of the Union. The principal claims are the Italie, the Gold Park Consolidated, the Mohawk-Nevada and the Barber. Some exceptionally high-grade ore is being taken from the first named mine, and the Gold Park property is also yielding well. A 10-stamp mill is about to be erected, and a pipe-line will bring water to the mines, which are in the foothills to the southwest of Twenty Nine Palms.

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Illustrated.

Iron and Steel Production of the World

The pig-iron production of the world, which increased rapidly in 1905 and 1906, in 1907 showed a comparatively slight change from the previous year, the gain being only 2.7 per cent. The figures, as collected for *The Mineral Industry,* are given in the following table, reduced to metric tons for purposes of comparison:

PIG IRON PRODUCTION OF THE WORLD.

Metric Tons.

	1906.	1907.	Changes.
United States	25,712,106	26,193,863	I. 481,757
Germany	12,478,067	13,045,960	I. 567,893
Great Britain	10,210,178	10,082,638	D. 127,540
Three chief producers.....	48,400,351	49,322,461	I. 922,110
Canada.....	550,618	590,444	I. 39,826
Belgium.....	1,431,160	1,427,940	D. 3,220
France.....	3,319,032	3,588,949	I. 269,917
Other Europe....	4,723,700	5,125,220	I. 401,520
Other countries..	650,000	625,000	D. 25,000
Total.....	59,074,861	60,680,014	I. 1,605,153

As for several years past, the United States was far in advance in 1907, furnishing 43.2 per cent. of the pig iron of the world. Its production exceeded that of its two chief rivals, Germany and Great Britain, together by 3,065,265 tons. These three countries made together 81.3 per cent. of the total pig-iron production. Germany made the largest proportional gain, while Great Britain showed a small loss from the previous year. In other European countries there was a considerable gain, chiefly from France and Russia. Consumption of iron was, apparently, at a standstill, since such reports as are made indicate that unusually large stocks of unsold or unused iron were held by the producers at the close of the year, in almost all countries.

The production of the pig iron as reported in the table, required the movement of nearly 250,000,000 tons of material—ores, flux and fuel.

STEEL PRODUCTION OF THE WORLD.

Metric Tons.

	1906.	1907.	Changes.
United States	23,772,506	23,733,391	D. 39,115
Germany.....	11,135,085	12,053,632	I. 918,547
Great Britain....	6,565,670	6,627,112	I. 61,442
Three chief producers.....	41,473,261	42,414,135	I. 940,874
Canada.....	515,200	516,300	I. 1,100
Belgium.....	1,185,660	1,183,500	D. 2,160
France.....	2,371,377	2,677,805	I. 306,428
Other Europe....	3,670,500	3,986,600	I. 316,100
Other countries..	420,000	405,000	I. 15,000
Total.....	49,635,998	51,183,340	I. 1,547,342

The steel production of the world showed a little larger proportionate gain than that of pig iron, the increase having been 3.1 per cent. This was due to the increasing proportion of pig which is converted into steel. The figures for this make of steel for two years are as shown in the accompanying table, the output of all countries being converted into metric tons, for purposes of comparison.

Here, as in pig iron, we find a great preponderance in the make of the three leading producers. The United States alone made 46.4 per cent. of all the steel; while the United States, Germany and Great Britain together furnished 82.9 per cent. of the total. Germany uses the highest proportion of pig in the making of steel, and Great Britain the least. The proportion of steel to pig-iron production, which was 92.4 in Germany, was 90.6 in the United States, and only 65.7 in Great Britain. Wrought iron is still an important part of British production; much more so than in any country except Belgium and Sweden.

Translated, these figures mean that the iron and steel industries in 1907 reached the top of the wave of prosperity, and that receding movement began. This change was more sudden and more sharply marked in the United States than elsewhere. The industries of Europe have felt it to a considerable degree, however, as a decline in their production has set in. Stocks are piling up, and there is a general hunt for foreign markets. It is now beyond doubt that both pig-iron and steel production will show a considerable drop in the current year, all over the world.

The Loss of Property by Fire

Attention has lately been directed in specific ways, largely through the instrumentality of President Roosevelt, to the alarming waste of the natural resources of the United States. In this connection it is well to consider more seriously the waste of property derived from our natural resources after the latter have been realized in marketable form. The waste in the utilization of fuel, food, and indeed in almost all commodities is something that almost passes belief. If these enormous wastes could be reduced only 20 per cent., or even only 10 per cent., the increase in the wealth of the nation would be so rapid that the whole world would marvel.

Among the great wastes is the unnecessary destruction of property by fire, to which the underwriters have been calling attention for years, without producing any great impression. Powell Evans has reverted to this important subject in an ad-

dress delivered before the National Association of Manufacturers, at New York, May 20, 1908. He stated that the annual fire loss of the United States, on a 10 years' average, for the years up to the end of 1902 (prior to the great Baltimore and San Francisco fires) was $146,552,365; and up to 1908 was $198,181,188. In 1907 the fire loss was $215,671,250. Moreover, it is estimated that more than one-third of forest destruction arises from fire waste, largely preventable. The country now sees that too much timber is annually cut and used. Mr. Evans asks: "Why not lessen this by substantially banishing wood from building construction in our cities, the use of which constitutes a large part of the timber demands, and is at the same time a prime cause of conflagration? He points out that two admirable and practical causes can be effectively served by this one step of minimizing the use of wood in city building codes all over the United States, namely our timber supply will be preserved and our fire losses will be reduced.

Valuing and Taxing Unmined Coal

A case of some interest is on trial in the Lackawanna county court at Scranton, Penn., which involves the value of anthracite coal lands. It is the appeal of several coal companies from the assessments for taxation made on their lands by the county board. The valuations placed on the lands are very much greater than in previous years, and the companies claim that they are entirely too high. It appears that the county commissioners employed engineers to survey the companies' lands, ascertain the probable quantity of coal unmined, and place an approximate valuation upon the properties. So far as the approximate extent of coal lands and quantity of coal mined goes, the engineers seem to have been moderate; in fact their estimate of unmined coal is not seriously questioned in the appeal. The main point is in the valuation of the coal.

The engineers in their report, which was substantially adopted by the county board, placed the value of coal at $100 per foot-acre. That is, they put the value of coal in the ground at $100 per acre for each foot in thickness of the vein. Each foot-acre will contain approximately 1800 tons of coal, which would make the value of the gross quantity of coal in the ground about 5.5 per ton, with no allowance for waste or for unminable coal. This corresponds in some degree with the practice of those companies which make an allowance for amortization or depreciation in value of coal lands, the usual amount so allowed being 5c. per ton mined. On the other hand it does not correspond with recent sales of coal lands. The largest transactions reported in the anthracite coal country for several years were the purchases made by the Delaware & Hudson Company last year, which covered lands estimated to contain a little over 650,000,000 tons of coal. The total price paid for these lands was an average of 0.8c. per ton for the gross amount, or 1.23c. per ton of minable coal, an allowance of about one-third being made for waste or unminable coal. The actual selling price of these tracts, in a period of high prices, was only about one-sixth of the Lackawanna county assessors' figures.

This wide difference is only another instance of the lack of any just or uniform basis for the assessment of mining property. The Pennsylvania court is taking much testimony as to the real or supposed values; but that evidence so far does not seem to shed much light on the case. Nor is it probable that the decision of the court will be either final or specially enlightening.

Lead and Spelter

The past week has been one of the rare periods when lead and spelter have sold at the same price, spelter being commonly worth 0.5 to 1c. per lb. more than lead. At the nadir of the depression in 1907 spelter was at 3.97½c. and lead at 3.40c. Since then both metals have recovered substantially, but lead much more than spelter. This has been due particularly to improvement in business among the corroders, whose product is used for painting. Possibly the abundance of labor and lower wages have led many persons to take advantage of the opportunity to do necessary painting on and in buildings. At all events the stock of unsold lead, which was large at the beginning of the year, has dwindled to comfortable proportions.

On the other hand, spelter has all along been the weak sister among the metals, the demand from galvanizers and brass-makers having continued poor, while the trade in sheet zinc has been below the normal mark. A large stock of unsold metal has hung over the market ever since the first of the year, when it was about 33,000 tons. It has diminished somewhat, but still is large. In the trade it is believed to amount to 25,000 tons even now. Of course, no strength could be looked for in this market while this condition existed. Indeed, the wonder is that the price has been so well sustained. However, the stock has been in strong hands; but even they may become tired if they have to carry the load too long.

What European Miners Want!

The International Miners' Congress, at Paris, has declared itself in favor of the nationalization of mines; but only on condition that the labor unions of the miners be maintained. All workmen in the mines are to be Government employees, with the privilege of going on strike against the Government, and the power of dictating to the Government as to whom it shall and shall not employ and of excluding non-union men from Government employment.

Any comment upon these modest demands would be superfluous.

Pig Iron Production in the United States in 1908

The production of pig iron in the United States for the five months ended May 31 has been at the rate of a little less than 14,000,000 tons a year. Should there be no improvement during the later months, this would mean a decrease of about 11,500,000 tons from the make of 1907. There are already indications, however, that the reduction will hardly be as great as this; though there will be, undoubtedly, a heavy falling off in the total for this year, as compared with last. The decrease in steel-making pig has been slightly greater than in foundry and forge iron. As a result of this condition shipments of coke this year have fallen off more than one-half; while there has been little traffic in iron ore beyond the shifting of accumulated stocks.

H. Y. L. Brown, government geologist of South Australia, states that 21,000,000 tons of 66-per cent. iron ore and manganiferous iron are in sight in the deposits at Iron Knob, 40 miles from Port Augusta.

Views, Suggestions and Experiences of Readers

Comments on Questions Arising in Technical Practice or Suggested by Articles in the Journal, and Inquiries for Information

CORRESPONDENCE AND DISCUSSION

Berry's Safety Crosshead for Sinking

My attention has been called to E. M. Weston's article on, "Sinking Crossheads," in the JOURNAL of March 7, also to a paragraph in the editorial column of the same date, specially calling the attention of mining men to the simplicity of the device designed to prevent the crosshead as a guide to the bucket down to the last timbers from being left behind, and also to avoid "the danger of the bucket hanging to the Berry crosshead" when on the stops.

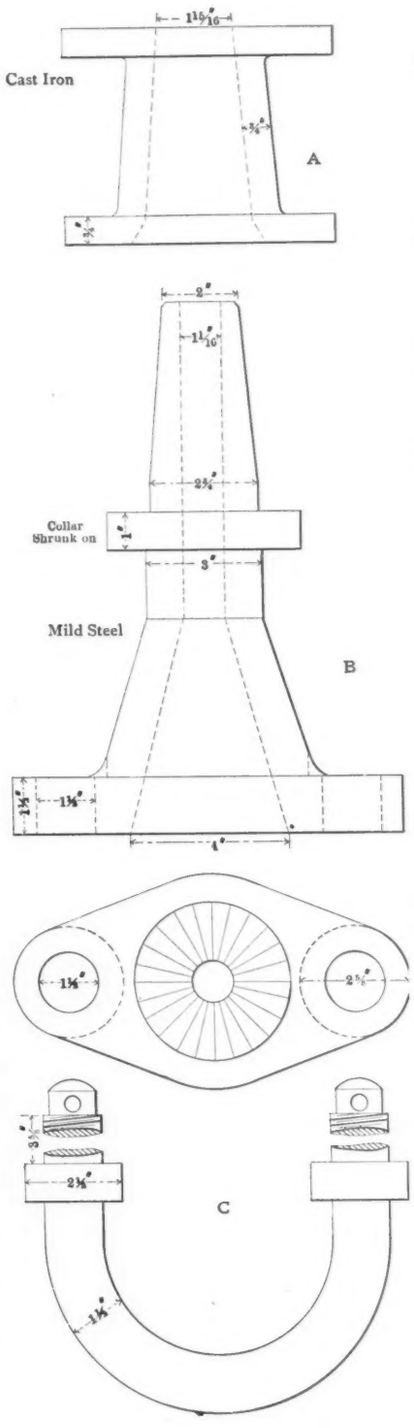
Since we are both trying to introduce the best devices for rapid work with increased safety, and Mr. Weston draws attention to what he considers a weak point in my device, I am taking this opportunity of drawing attention to what I consider the weak points in his arrangement.

With the arrangement illustrated the "adhesion" depends on how the taper fits and the force applied by the engine driver when picking up the crosshead. In practice a cone jammed into a taper socket (such as a twist drill in a drilling machine or a machine-drill jumper with taper shank) has an unknown amount of adhesion. A bur or a piece of grit will upset the most nicely calculated taper grip; hence great care will be necessary to see that the tapers are not damaged. It would also be necessary to test periodically the adhesion hoisting the bucket up and lowering rapidly about 2000 ft. before bringing it to rest slowly, and then determining the amount of adhesion.

In practice all ropes tend to spin, and the crosshead rocks, upon the point of the cone as a pivot, the slack left between the guide and the runner. This rocking, vibration and twist would tend to release any adhesion left after the bucket had been dumped, unless the cone were jammed home so tight that the bucket would remain suspended, the engine driver running out slack rope at the stops.

Should an obstacle be met during a rapid descent, say, the head of a coach screw or bolt, the shock would release the bucket and leave the crosshead behind, as it is designed to do when arriving on the stops of the bottom timbers, without any indication of adhesion. To have to surmise after an accident that there had not been enough adhesion, would be a poor explanation.

The accident due to the bucket's being held up on my crosshead which occurred at one of the mines, was the result of the stops being set so much out of level that one lever only operated. To make the gear fool-proof I coupled both sides with a connecting-rod as shown in the sketch, so that the levers operate both drawbars simultaneously even if only one side is provided with stops.



THE WESTON IMPROVED SHACKLE FOR HOISTING BUCKETS

ANOTHER DESIGN

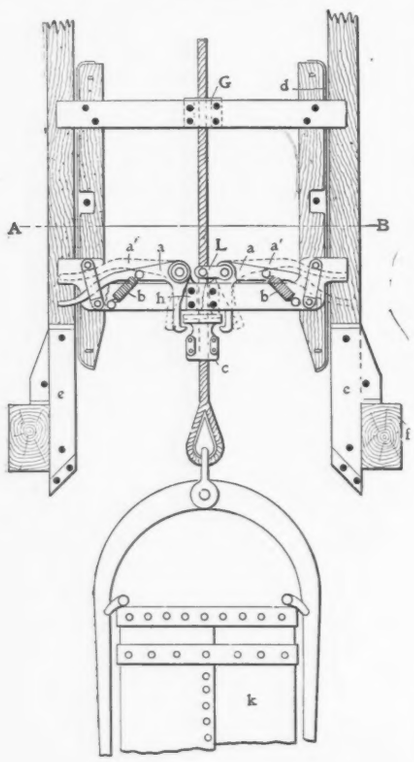
The other design of my crosshead shown in the accompanying sketch has both hook levers connected to operate from one side. This device has fewer joints, pins, levers, etc., to get out of order, and the hooks can be given plenty of clearance when disengaged, so that it is impossible to hang up a bucket at the stops. Four of this design and two of the design referred to in Mr. Weston's article were in use at Simmer West and Jupiter shafts at a depth of nearly 4000 ft., or until sinking was finished in the vertical. These shafts hold the record for vertical shaft sinking at great depth. Simmer West in one month made 203 ft., and the Jupiter the highest average number of feet per month throughout a year. R. M. Catlin, at that time general manager of these mines and others of the Goldfield Deeps gave me a testimonial for the crossheads working in five shafts. The Transvaal government safety-catch commission took evidence on sinking with skips and cages *versus* buckets, and two witnesses, R. M. Catlin and Leslie Simson, gave evidence in favor of buckets, when fitted with an approved crosshead similar to "Berry's." The findings of this commission contains valuable information on winding ropes and safety-catch tests and was published in book form last year.

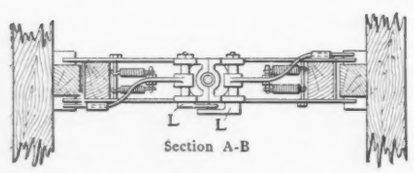
In view of these facts and the successful tests made with my crossheads by the government mining engineer and his assistants as far back as 1902, the crossheads still in use furnish sufficient proof that the device is most reliable under ordinary care.

The Brodigan improved shackle for hoisting buckets is an excellent fastening and admits of close connection to the crosshead to overcome the swinging of the bucket after entering the timbers. Sinkers as a rule, however, prefer to have some head room between the bucket and crosshead, which, although safe enough when working under a geared hoist is often dangerous with a large direct-acting hoist, since the engine driver may set up a series of jerks and shocks in the hauling rope like the crack of a long whip, the bucket striking the timbers and putting a

severe strain on the bridle fastenings and crosshead.

I quite agree that a swivel should be use, no matter how short the connection to the crosshead, or whatever make of rope is used in sinking, and on no account should a ball-bearing swivel be used. An eye bolt could be substituted for the hook if a drop pin is used for changing buckets. In my crosshead two small projections are cast under the center brasses; these correspond with a





a, lever engaged; *a'*, lever disengaged; *b*, spiral springs; *c*, rope clamp; *d*, sheathing; *e*, stops; *f*, bottom divider; *G*, top brasses; *h*, bottom brasses; *k*, sinking bucket; *L*, levers to connect the sides.

BERRY'S SAFETY CATCH FOR CROSSHEADS OF SINKING BUCKETS

slot in the rope clamp which prevents the bucket's acquiring a spin while traveling through the shaft.

J. BERRY.

London, May 25, 1908.

According to Consul-General Henry B. Miller, Japan imported 488,434 tons of pig iron, steel and steel manufactures in 1906, of which the United States contributed 55,289 tons. These imports do not include large quantities imported for military and naval uses.

The Use of Steel Tamping Bars

I notice in the JOURNAL of June 27, on page 1299, the following: "The use of steel tamping bars in coal mines should be prohibited, for if they strike a sulphur ball when a hole is being charged, they sometimes make a spark which lights the powder and causes an explosion. All tamping bars should be copper tipped." For the past four years the du Pont company has made a special study of accidental explosions in the United States. In addition to this we have records of accidents of the English government inspectors of explosives for a period of about 35 years. From these records we find a great many accidents have been caused in tamping holes when copper, brass and aluminum-tipped tamping rods have been used. We have come to the final conclusion that the only safe rod to tamp bore holes should be made of wood. Several of the largest coal companies in this country have also come to this conclusion, and prohibit the use of anything but wooden tamping rods in their mines.

F. H. GONSOLUS,
Manager Technical Division,
E. I. du Pont de Nemours Powder Company.

June 27, 1908.

Properties of Explosives

I notice in the JOURNAL of June 6, 1908, on page 1144, the following quotation: "Dynamite containing less than 30 per cent. of nitroglycerin cannot be detonated."

I feel it my duty to call attention to the error of this statement. Dynamite has been successfully manufactured in grades as low as 12½ per cent. We sell today an enormous amount of dynamite containing less than 30 per cent. of nitroglycerin. One of our customers uses a carload every five days of a dynamite which carries only 15 per cent. of nitroglycerin. Also a great many of the coal mines use a dynamite carrying 20 per cent. The author who wrote this statement may possibly have been thinking of the old kieselguhr dynamite. In this the absorbant was the inert infusorial earth called kieselguhr. Dynamite manufactured with this absorbent was considered impossible to detonate when the percentage of nitroglycerin was below 40 per cent. The dynamites manufactured in this country today have a definite formula for each grade The absorbent can be considered a crude powder which adds to the strength of the explosive, and it is a great mistake to make a statement that dynamite carrying less than 30 per cent. nitroglycerin cannot be detonated.

In the JOURNAL of June 13, 1908, on page 1201, appears the statement: "The various grades of dynamite are made by adding more or less nitroglycerin to the absorbent." While this is true in a general way, at the same time it is liable to lead people unfamiliar with the composition of explosives to have an erroneous opinion of their composition. The standards which are used to designate the strength of high explosives are the different grades of straight dynamite which contain the actual percentage of nitroglycerin given. The absorbent used with each grade of the different classes of dynamite is made up on a certain definite formula designed to balance the explosive reactions, give a maximum efficiency and make a minimum of deleterious fumes.

On page 1154 of the JOURNAL of June 6, 1908, you make the following statement: "Contact with water lowers the efficiency of dynamite." The exception we take to this statement is that it is a little too broad. The gelatin dynamites are very nearly waterproof. In fact the higher grades will keep practically as well under water as they will in the air.

F. H. GONSOLUS,
Manager Technical Division,
E. I. du Pont de Nemours Powder Company.

June 13, 1908.

Prospects for Mining Engineers in Australia

I have received several letters from mining men in the United States asking as to chances in Australia. Readers of the JOURNAL may be interested in the reply that I have made to these inquiries.

I do not think that Australia is a good field for young men from foreign countries, inasmuch as its several universities and mining schools are turning out a good many well-trained young men, who are taken on as "experience men" at the various mines. The local supply is in considerable excess of the demand. There are many mining men in the Commonwealth, who hail from the United States, especially in base-metal mining. When metals rule high in price there is a big demand for mining engineers and metallurgists, and an experienced man has a good chance, but at present conditions are bad and large numbers of good men are out of positions.

GERARD W. WILLIAMS.

Melbourne, Victoria, April 29, 1908.

According to a recent British consular report on the mineral resources of the Dominican Republic, platinum is found in Jarabacoa and Guanuma; quicksilver in Santiago, Banico, Azua, San Cristobal, and in the San Francisco hill near Santo Domingo City. Tin deposits are said to exist in Seybo and in the Higuei, province of Seybo.

Annual Report on Production of Butte Mining Companies

SPECIAL CORRESPONDENCE

The annual reports of the mining companies, required by law to be filed with the county assessor, were made public last week, and show the earnings for 1907. In view of the fact that the price of copper has been low for some months, and also that the mines were shut down about three months during the period covered by the report, it is considered that the showing made by the different companies is very good. The North Butte and Red Metal companies, inasmuch as they sell their ores to the Washoe smelter on delivery, have not given any figures showing the cost of marketing. The Parrot company was the only one unable to show any net earnings. The accompanying table embodies the report of the various large producing companies.

REPORT OF BUTTE MINES FOR 1907.

	Anaconda.	Boston & Montana.	Butte & Boston.	North Butte.	Washoe.	Red Metal.	Trenton.	Parrot.
Tons of ore extracted	976,685	824,420	193,830	284,003	115,620	234,960	85.260	57,964
Gross proceeds	$9,775,118.65	$7,511,479.99	$1,609,763.66	$3,224,763.01	$1,052,956.73	$2,080,249.34	$646,109.31	$457,479.86
Cost of mining	$3,905,222.28	$3,262,266.55	$639,379.71	$990,405.55	$487,268.56	$1,070,272.97	$303,987.68	$380,593.97
Freight on ore	$733,352.81	$101,455.75	$39,472.92	$55,305.36	$14,602.81	$53,628.53	$10,318.42	$8,125.93
Cost of reduction	$2,957,965.15	$2,225,884.17	$444,020.91	$1,065,404.11	$221,881.11	$884,537.21	$203,843.39	$156,416.42
Cost of marketing	$617,513.18	$788,998.27	$191,285.30	.....	$83,028.19	.....	$60,700.48	$51,714.88
Total cost	$8,214,053.42	$6,378,604.74	$1,314,158.84	$2,111,115.11	$806,860.67	$1,908,438.71	$574,939 97	$596,851.20
Net earnings	$1,561,065.23	$1,132,875.25	$295,604.84	$1,113,647.99	$246,096.06	$71,810.63	$67,259.34	.....

Chronology of Mining in June

June 1—The Amalgamated Copper Company reports to its stockholders a loss of $7,500,000 in net income for the year. One thousand coke ovens of the Stonega Coal and Coke Company resume operations after an idleness of several weeks.

June 2—United States Steel Corporation reduces the price of bar steel from $32 to $28 per ton.

June 3—A deputation from the Mexican Chamber of Mines calls upon Minister Molina and enters formal protest against the provision in the proposed new mining law restricting the ownership of Mexican mines by foreigners.

June 4—The price of bar iron is reduced $3 per ton.

June 5—Appraiser Starretts hands down a customs decision classing diamonds used in mining with precious stones.

June 9—Conference of steel manufacturers decides to cut prices of all steel-finished products excepts rails. A reduction in the price of ore is also agreed upon.

June 10—Mohawk Mining Company declares a dividend of $2.50 per share.

June 17—Plant of the Royal Mines at Argentine, Penn., is destroyed by dynamite explosion ascribed to labor troubles.

June 18—Bar iron sold on "open market" basis. Bar steel and merchant steel sold at lower prices.

June 19—The Colbran-Bostwick claim to $2,000,000 mining property is definitely settled, the decision involving liberal terms to former owners of the property. Two thousand miners in Colorado coalfields quit work, affecting 30 mines.

June 20—Explosion in Elsworth No. 1 mine of the Pittsburg Coal Company, Monongahela City, Penn., kills several miners and injures others.

June 22—Eleven men killed in an explosion of firedamp in the Loire colliery at St. Etienne, France.

June 23—Fires ordered lighted in 1000 Rainey coke ovens in the Connellsville district.

American Smelting and Refining Company

As is well known, there have been many important changes in the administration of this company during the last six months. Apropos of these, Daniel Guggenheim is quoted as saying, upon his return from Europe:

"Before I left for Europe I set the ball rolling by reducing my own salary, and my brothers, who devote their entire time to the affairs of the company, also voluntarily reduced their salaries. Like all well-managed companies, we cleaned out our Augean stables last spring, and the cleaning process has now been completed. While our salary list alone is reduced by $750,000, I am informed that the efficiency of our labor has greatly improved, and this means another important saving in expenses."

The contract between the Guggenheim Exploration Company, and A. Chester Beatty expired June 1, and has not yet been renewed, but Mr. Guggenheim says that in all probability Mr. Beatty will remain in the Guggenheim employment and will be the manager of the Guggenheim Exploration Company.

Calumet & Hecla

In the trial of the case between A. S. Bigelow and the Calumet & Hecla, Alexander L. Agassiz, president of the latter company, recently testified that in his opinion the probable life of the conglomerate mine of the Calumet & Hecla is between 10 and 15 years. It is hoped that the company will develop a sufficient amount of copper in the properties recently purchased to replace the old mine. Mr. MacNaughton, general manager of the Calumet & Hecla, confirmed the estimate of President Agassiz as to the life of the conglomerate mine. He stated that in 1905 about 720 acres had been wholly worked out, leaving about 320 acres developed, 320 acres in which there is a fair prospect of finding copper, and 1960 acres known to be barren. The mineral land of the Calumet & Hecla consists of 2680 acres, of which 1960 are underlain by the Calumet & Hecla conglomerate, 2200 by the Osceola amygdaloid and 2500 by the Kearsarge lode.

Four shafts on the Calumet & Hecla conglomerate are to be abandoned during the coming year. Within two years Hecla No. 3 will be abandoned, and probably within three years Hecla No. 2 will be abandoned. In the 640 acres above referred to there still exists in the conglomerate formation between 20,000,000 and 25,000,000 tons of copper ore. The yield of the ore mined in 1906 was a very little over two per cent. The total value of the company's equipment is roughly between $15,000,000 and $16,000,000.

In the fiscal year ended April 30, 1906 the cost of mining and milling ore from the Osceola amygdaloid was as follows: Mining, 96.93c.; hoisting, 10.1c.; rock house, 13.36c.; transportation, 8.44c.; milling, 26.31c.; other costs, 1.8c.; total, $1.5694.

A recent British consular report states that the salt deposits in the mountains west of Neyba (Barahona), Dominican Republic, are supposed to be inexhaustible. The salt obtained is clear and transparent, and perfectly pure. There is at Caldera bay a natural salt-pond of considerable extent, where salt is also obtained from sea water by solar evaporation during the dry season.

Personal

H. N. O. Spicer has returned to Denver, Colo., after a professional trip to Mexico, lasting three months.

S. F. Shaw has established an office as consulting engineer for mine and mill work at San Bernardino, California.

Hugh Sutherland has returned to Haileybury, Ont., from Rawhide, Nev., where he has been for several months.

P. G. Lidner, of New York, has gone to New Liskeard, Ont., in the Cobalt mining district, on professional business.

Frederick Kruse, of Central City, Colo., is examining mines in the Telluride, Colo., district in the interests of eastern investors.

Daniel Duryea, manager of the Empire Zinc Company in the Joplin district, has gone to Arkansas to examine some zinc mining claims.

C. Berthold Conlin has returned from an extended tour of Chihuahua, Mexico, in the interests of the Packard Mining and Milling Company.

Marshall D. Draper, of Denver, has been appointed superintendent of the Fifty Gold Mines Corporation at Black Hawk, Gilpin county, Colorado.

S. F. Stoughton has been appointed general manager of the Stoughton Mining and Milling Company at Breckenridge, Summit county, Colorado.

Harold Baxter and J. R. Hoyt have formed a partnership as consulting mining engineers, with offices in New York and Wendendale, Arizona.

Prof. H. B. Patton, of the Colorado School of Mines at Golden, Colo., has been examining mines near Black Hawk in Gilpin county, Colorado.

James P. Evans has been appointed superintendent of the Colorado Iron Works Company, Denver, Colo., to succeed J. H. Morcom, recently deceased.

Frederick Lyon, of Kennett, California, has been appointed assistant managing director for the United States Smelting, Refining and Mining Company.

Gerard W. Williams, who has been visiting the leading mining fields of Australia, is now engaged in some metallurgical research work at Melbourne, Victoria.

L. W. Trumbull, of Downieville, Cal., is in Montana making an examination of placer ground. He expects to make a visit to Denver before returning to California.

George G. Vivian, formerly of Georgetown, Colo., has been appointed superintendent of the smelter and milling plant of the Pittsburg & Montana Copper Company at Butte, Montana.

S. F. Bretherton, general manager of the Great Western Gold Company, Ingot, Cal., has returned to his office, San Francisco, after an extended trip of inspection of the company's mines and branch railroad in Shasta county.

Paul L. Wolfel, formerly chief engineer of the American Bridge Company, and lately consulting engineer for the American Bridge Company of New York, on July 1 became chief engineer of the McClintic-Marshall Construction Company, with headquarters in Pittsburg.

Captain William Allen has resigned his position as superintendent of the Newport iron mine near Ironwood, and has removed to Negaunee, Mich., Captain Allen has had charge of a number of mines in the Lake Superior region, beginning with the Humboldt, about 40 years ago.

Dr. George I. Adams, formerly in the United States Geological Survey and lately with the Corps of Engineers of Mines of Peru, has been appointed geologist in the Bureau of Mines of the Philippine Islands and sailed from San Francisco on the "Mongolia" June 30. His address will be Bureau of Mines, Manila, P. I.

Dr. E. M. Shepard, professor of mineralogy and geology and dean of Drury College, Springfield, Mo., has resigned from active service to accept the Carnegie pension for retired professors. Dr. Shepard has been a member of the Missouri Geological and Hydraulic surveys and has done much valuable work in the Ozark region.

Otto C. Burkhart has been appointed professor of mining in Virginia Polytechnic Institute at Blacksburg, Va. He will begin his work in July, and upon him will devolve the organization of the mining department. Mr. Burkhart is a graduate of Lehigh University, and besides much experience in mining and blast-furnace work, he has served on the staff of the ENGINEERING AND MINING JOURNAL, and as assistant professor at Lehigh University.

Obituary

William H. Lees, general manager of the Cuartas mine in the Ayutla district, near Guadalajara, Mexico, died at the mine June 19, of heart failure. He was a prominent member of the American colony of Guadalajara.

Henry Lomb, who died in Rochester, N. Y., June 13, aged 79 years, was one of the founders of the firm now known as the Bausch & Lomb Optical Company, and was one of the oldest and best known makers of surveying and optical instruments in this country.

George Riley, of Idaho Springs, Colo., died suddenly in Denver, June 23. He was born in Dover, N. J., in 1855, and went to Colorado in 1879, where he began mining in the Clear Creek district. He had been manager of the Franklin mine for several years, and was interested in several other mines. He was twice elected mayor of the city of Idaho Springs.

Samuel L. Wharton, who died in Spokane, Wash., June 25, aged 61 years, was born in Charleston, S. C., and had resided in Georgia and Texas, but for 18 years past had made his headquarters in Spokane. He was interested in several mines in Washington and Idaho; was vice-president and a large stockholder in the Reco Mining Company at Sandon, in the Slocan district in British Columbia; and owned several gold mines in the Dahlonega district in Georgia.

Societies and Technical Schools

Iron and Steel Institute, Great Britain—The autumn meeting, it is announced, will be held at Middlesbrough, England, Sept. 28-Oct. 1. A large number of papers will be presented.

Missouri School of Mines—The 1908 catalog of this school at Rolla, Mo., shows a total of 203 students. The school is well equipped with chemical and physical laboratories, and offers complete courses in mining, engineering and geology and in metallurgy.

Mine Inspectors' Institute of America—This association has been organized, at a meeting of State mine inspectors held at Indianapolis recently. The officers chosen were George Harrison, of Ohio, president; Thomas Moses, of Illinois, vice-president; Thomas Hudson, of Illinois, treasurer; James W. Paul, of West Virginia, secretary. The purpose of the organization is to hold meetings of the mine inspectors of the country to discuss means for the prevention of mine accidents.

Columbia University—The following courses counting toward the degrees of the schools of mines, engineering and chemistry, open without examination to all students who are qualified, are offered in the summer session of Columbia University, New York, July 7 to Aug. 14:

Civil Engineering—Hydraulics, five hours lectures per week; structures—reinforced concrete, five hours lectures per week.

Electrical Engineering—Electric train movement, six hours lectures per week.

Mechanical Engineering—Gas engines, six hours lectures, six hours laboratory per week.

Metallurgical Engineering—Metallography of iron, steel and industrial alloys, five hours lectures, five hours laboratory per week, Prof. William Campbell.

Also chemistry, mathematics, mechanics, mineralogy, physics, and shop work. All these courses will be of special interest to instructors in technical schools, to graduate students and to practicing engineers.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at Goldfield, Butte, Salt Lake City, Denver, Toronto and London

REVIEWS OF IMPORTANT EVENTS

Goldfield, Nevada

June 23—The Las Vegas & Tonopah railroad has announced a reduction in freight rates on ore beginning August 1, which will amount to practically $3.50 per ton on all Goldfield ores. This is a very great advantage to the small mines and leasers and will undoubtedly stimulate shipments which have been held back by high freight and treatment charges. A few more railroads and a few more mills and Goldfield will shake off the "highbinders" who have been making conditions such that anything under $50 was low-grade ore.

The Secretary of the Mine Operators' Association estimates that there are at least 1800 miners now employed in the camp. The monthly payroll amounts to $200,000 which is equivalent to a week's output from the mines. There are 18 shipping mines and leases in the camp at present.

Salt Lake City

June 27—Copper at 7.7c. per lb. is what the cost sheet of the Utah Copper Company shows for May. Although this information has not been confirmed by General Manager D. C. Jackling, the figures are known to be absolutely correct. During the month stated the mine produced 4,139,529 lb. of copper, as against 3,323,000 lb. in April. From the mine was despatched daily an average of 120 carloads, each containing 50 tons of ore, to the concentrating mills at Garfield and Copperton. Nine 500-ton sections of the latter were in continuous operation; the tenth is now in commission and the eleventh will be running early in July. So the company is rapidly approaching the basis for a 60,000,000-lb. annual copper production, provided, of course, that the present grade of ore is maintained at the mill. The Utah Copper Company is now operating on its own account in the Bingham camp at least 10 miles of standard-gage railroad and has additional trackage under construction as a preliminary to the opening of new levels for the steam shovels higher up on the mountain. The removal of overburden from the ore-deposits and its dumping about two miles away, will be an important item in next year's operating costs.

The Utah mine at Fish Springs has disbursed the usual monthly dividend at $3000. The May Day mine in Tintic is also on a dividend basis again, the May distribution was $8000.

Actual development of the Juab oil district in Juab county has been begun by the Juab Oil Company, in which officials of the Salt Lake route are interested. A drill rig capable of going to 2000 ft. depth has been installed.

Two of the Majestic Mines Company's mines have been placed in operation again; they being the Harrington & Hickory and the O. K. mines, the former being a lead-silver and the latter a copper producer. Both mines are located in Beaver county.

The hearing on the application of the Silver King Consolidated for an order of court permitting its engineers to enter certain workings of the Silver King Coalition mine, alleged to have entered disputed territory has been concluded. The case has been taken under advisement by Judge Marshall, of the Federal court. The Consolidated company has charged the defendant with having wrongfully extracted ore.

Butte

June 25—The Great Northern railway will probably be opened for traffic between Butte and Great Falls the latter part of this week. The Boston & Montana smelter, however, will not be ready to receive ores for another month. Mining operations in and around the city of Butte are still somewhat curtailed as a result of the shutdown of the Boston & Montana smelter and the difficulty experienced with gases in the Anaconda and St. Lawrence mines. These mines have been closed down for the past few days. The Anaconda company recently completed a new plant for the drying of the precipitates which are made at its plant in Meaderville. The precipitates have heretofore been sacked while wet and have failed to dry out satisfactorily before reaching the blast furnaces, and it is to obviate this difficulty that the plant was constructed.

Denver

June 30—As an echo of the recent conference at Washington of the governors of the various States, Governor Buchtel, of Colorado, made an address on June 24 before the Denver Real Estate Exchange, advocating the appointment of a forestry commission, with ample powers to preserve the timber resources of the State, and the passing of such laws as will bring about proper working of the coal mines of Colorado.

Representatives of the various northern Colorado coal miners' unions have held a meeting, and formulated a new scale of wages, which will be submitted to the unions, and if accepted by them, will then be presented to the operators. It is believed by the miners that the new scale will be agreed to by the mine-owners. About 2500 miners are idle, though no strike has been formally called, and so far there has been no violence committed, nor bitter feelings manifested.

Regular passenger service on the new Denver-Boulder electric line was inaugurated June 26, on a temporary schedule of six trains each way per day, or a train every two hours. It is expected to double this service shortly, putting on 12 trains per day, and giving hourly cars between the places named.

The Wisconsin, formerly one of the heaviest producers of the Clear Creek district, is now being operated by lessees, and has re-entered the list of shippers.

A 4-ft. vein, yielding high assays in gold and silver, is reported to have been struck in driving the Saratoga lateral at a point 2300 ft. east of the Newhouse tunnel.

It is reported that the United States Geological Survey is to make an examination of the Breckenridge district, the work to begin in August.

On June 24, more than the average amount of ore was shipped by the mines of Cripple Creek, over 30 properties not on the various railroad lines being on the list of shippers, in addition to those mines loading directly into the cars. A large proportion of the shipments was made by dump lessees.

Upon inquiry of a broker in Colorado Springs, we find that the Bombay Gold Mining Company, and the Manhattan Consolidated Gold Mining Company, are both probably defunct, and there is, of course, no market for their shares. Our informant gives it as his opinion that "neither company is worth postage writing about it." The Secretary of State has no report from either company, as is required by law, and it is, therefore, probable that they are both dead. The properties of these companies are outside the producing area of the Cripple Creek district.

The mines of the Red Mountain district are busy getting to work, as the railroad which connects them with Silverton is now open and trains running, and great activity prevails. This may also be

said of the whole San Juan region, where most of the big mines are at great elevations, and where the snow has now sufficiently disappeared to permit active work.

At present, the most important new mine in the Red Mountain district is the San Antonio, in which the miners have opened a body of copper ore 30 ft. long by 25 ft. in width, with every indication of being persistent in depth. This ore is chiefly enargite, and is similar in character to the ores of the Congress, Hudson and National Belle, which were heavy producers from about 1886 to 1893, when the drop in silver shut most of these silver-copper mines down. The ores were treated at the Silverton pyritic smelter, and had associated with them nearly enough pyrite to make them suitable for that process. The average yield in copper of the San Antonio ore is high, and this was the case also in the other mines mentioned.

Joplin, Mo.

June 29—Several more mines in the Joplin district have been closed down this week as has been the case every week this month. Mines that produce little or no lead ore cannot meet the expense of the added expenditure for drainage necessary to hold the rising water in check from the proceeds of their zinc ore at present prices, and the pumps are being drawn after a losing fight to keep at the business. With the drainage proposition as 15 to 1 compared to this time a year ago, the expense of drainage has become an important item, so many mines having to run pumps now that did not a year ago, and all of them having the above ratio of increase in pumping costs to contend with.

Indianapolis

June 29—In affirming a judgment for $1000 recovered by complainant against the Chandler Coal Company, the Indiana Supreme Court recently held that the coal mine act of 1905 is constitutional and valid. The particular features of the statute attacked by the defendant company, as making it unconstitutional, were that which excuses from its operation mines employing less than 10 men, and that which makes a mineowner who fails to light a shaft absolutely liable for the injuries of any miner who is injured by falling down the shaft in the dark. Complainant was trying to enter the elevator cage half-way down a mine shaft, where there was no light, when he missed the cage and fell to the bottom of the shaft.

The Indiana statute requires two lamps at each shaft, "except when electric lights are used," and it was urged that this was an unfair discrimination against mines lighted by other means than by electricity. But the court says that this language merely means that two lamps are to be used, except when the shaft is otherwise sufficiently lighted by electricity, so as to be safe without lamps.

The court also declares there is no unjust discrimination in the provision that the act shall only apply when 10 men or more are employed in a mine, because this makes it apply to every mine where a large force is worked, and takes away every mine out of its operation when the force is cut down.

This decision settles a point of interest to the miners employed in small mines. An effort will be made to have the next Legislature amend the statute so as to make it apply to all mines, on the ground that all miners in the State are entitled to equal protection whether working in a small or large mine.

Toronto

June 27—The work of the Canadian Geological Survey has been considerably delayed this season on account of lack of supplies. Appropriations were made last week which have enabled the Survey to put additional parties in the field. W. McInnes has gone to South Indian lake and the Churchill river to explore a tract of country likely to be opened up shortly by the Hudson Bay railway. He will endeavor also to examine reported coal and copper discoveries north of Prince Albert, Saskatchewan. W. H. Collins has left for the Montreal river to study the economic geology of the region near the head waters. M. E. Wilson is working in the district north of Lake Temiskaming in Quebec Province. W. A. Johnson is continuing topographical and geological work in Simcoe county, Ont. J. A. Dresser has gone to conduct a geological survey along the line of the Grand Trunk Pacific railway between the city of Quebec and the New Brunswick boundary. G. A. Young is making surveys covering the iron range near Bathurst, N. B. A party in charge of Dr. R. W. Ells is mapping the oil shales in Albert county, N. B. Dr. Ells himself is at present in Scotland investigating the oil shale industry. E. R. Faribault has started for Nova Scotia to continue the work of mapping the gold-bearing rocks, and Hugh Fletcher is working in Cumberland county, Nova Scotia.

London

June 13—The big amalgamation scheme to pool the Farrar interests in the East Rand has been carried, and the names of several familiar producers, such as Angelo, Dreifontein, Cason and Comet, will now disappear. As to the fairness of the scheme there has been much discussion. Many of the shareholders in the producing mines would, no doubt, have preferred to remain as they were. Their mines were earning good dividends and they had no wish to share them with those who held deep-level ground of doubtful value, however cheaply such ground might be sold. The owners of the deep-level claims are now released from an embarrassing position. The work done on their mines has been of a disappointing character, and sufficient funds to bring them to the producing stage were not available. The advantages claimed for the scheme were three: increase in life, increased facilities for maintaining a regular grade of ore, and reduction of working costs and administration. Two of these advantages could have been obtained equally well by amalgamating the outcrop mines, and if the scheme had stopped there, probably little opposition would have been raised. The increase of life depends on whether the deep ground is payable or not, and the sellers of the deep ground have not in this respect a strong case, the developments as mentioned above having so far proved disappointing.

Other objectors took another line in opposing the scheme, which "Pioneer" well summarized in the *Economist* of May 16. The objections are: (1) That in some amalgamations the buyers and sellers are the same persons. (2) That very few directors are independent. (3) That shareholders in Europe have not proper representation at company meetings held in Johannesburg. (4) That in every amalgamation impartial experts should be employed to hold the scales with an even hand, and that the report of these experts should be submitted to the shareholders, so that they may judge for themselves whether to vote for amalgamation or against it.

The result of the voting at the meetings of the companies interested goes to show that the promoters and directors control the situation, and that the average independent shareholder does not take the trouble to record a vote. Out of the 1,000,000 East Rand Proprietary Company's shares only 285,336 shares voted, of which 1032 were in opposition. Nearly three-quarters, therefore, of the shareholders failed to vote. In the subsidiary producing companies the East Rand Proprietary held such a preponderating interest that no combination of shareholders could have thrown out the scheme.

It is evident that shareholders are at the mercy of those who control the companies, and it seems a pity that there is no independent shareholders' association to examine and report on schemes of this nature. It is not a healthy condition of affairs that such large interests should be bought and sold when only about a quarter of the shareholders—as appears to have been the case in the East Rand Proprietary Company—record their votes. Directors who are personally interested in two companies which it proposed to amalgamate are placed in an unpleasant position, and ought to welcome such an association as relieving them to some extent of any suspicion of personal bias. Hostility to such an association could only come from those whose schemes would not bear investigation.

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

Alabama

BIBB COUNTY

H. F. DeBardaleben has made all his arrangements to begin work on a new slope on his property in the Upper Cahaba coalfield. He is one of the promoters of the Alabama Fuel and Coal Company.

JEFFERSON COUNTY

All the coal mines in this county are being put back to work again as fast as they can be put in condition to operate.

WALKER COUNTY

Several of the large mines in this county have arranged to resume operations in July. The demand for coal is increasing steadily.

WASHINGTON COUNTY

Mobile Portland Cement Company—This company has been incorporated to build and operate a large portland-cement plant; also incidentally to operate coal mines. The cement plant will be erected at St. Stephens, where shipments can be made by water. The capital stock authorized is $6,000,000 common and $3,000,000 preferred. The incorporators are P. J. Lyons, E. L. Russell, Mobile, Ala.; C. H. Treat, Washington; W. W. Finley, New York.

Arizona

COCHISE COUNTY

Calumet & Arizona—The combined ore production from the mines is averaging about 1500 tons daily, of which 875 tons are from the Calumet & Arizona mines and 625 tons from the Superior & Pittsburg mines. The copper production at the smelter in Douglas will be well above 4,000,000 lb. for the month of June.

Superior & Pittsburg—The Hoatson is keeping up its shipments of 250 tons of ore daily. On the 1300-ft. level a crosscut has passed through 500 ft. of barren lime, but recently stringers of ore have come in, and the ground looks very promising. No. 1 raise which is coming up from the 1300 and is 125 ft. from the Queen side line, struck ore at the hight of 60 ft., and has already cut 20 ft. of 6 per cent. oxide ore. This proves that the large orebody on the 1200 extends 40 ft. below that level. The shaft, which is again being sunk, is 1470 ft. deep, going down at the rate of 1 to 1½ ft. per day.

Shattuck-Arizona—There has been a recent strike of good ore on the 600-ft. level in this company's mine. The new ore, which has been drifted on about 35 ft. up to date, is carbonate and oxide, carrying about 7 per cent. copper, and is high in iron, making it a very good smelting ore.

Dean-Arizona—Diamond drilling is still in progress from the 1100-ft. level. Nothing is given out in regard to the success of this drilling, but it is believed that no ore of importance has been discovered.

Wolverine & Arizona—Near the center of the Warren claim in this company's mine a recent discovery of a body of lead-silver ore has created considerable interest in the Bisbee district. The ore itself is not of great importance, but taken with the favorable-looking ground around the new orebody, the outlook for future copper discoveries is considered very good.

Warren Realty and Development—The Warren shaft is down 650 ft. One shift of 10 men is at work, six men in the shaft and four on the surface.

Anderson Apache Company—The company's mine is about six miles from Hachita, Grant county, New Mexico. Recently the announcement has been made that Geo. H. Neale, the mayor of Bisbee, is to become the president of the company. The purchase price of the property is $100,000, of which $20,000 has been paid. The outstanding stock is held almost entirely by Bisbee and Douglas men, and an additional 2000 shares of stock are to be put on the market in these two cities at $2.50 per share. The par value is $5 per share.

California

AMADOR COUNTY

Kennedy Mining and Milling Company The tramway for hauling supplies from Martell station to this mine at Jackson has been put in operation.

CALAVERAS COUNTY

Cramer—G. Nuner has a force of men opening this mine at Stockton Hill and has cut gravel supposed to be the lost Cramer channel of Star & Madison workings.

South Caroline—This mine, J. W. Bernard, superintendent, is having a 100-ton mill test of its ore made. The mine is next to the Melones, and it is expected that a 10-stamp mill will be put up.

EL DORADO COUNTY

Stony Bar—New machinery has just been installed in this mine four miles from Placerville, and some coarse gold is being taken out.

Standard Unit—This mine in Coloma cañon, Greenwood district, is being operated with a full crew of men.

INYO COUNTY

Ubehebe—For this place in the southern and eastern end of the county freight teams are hauling supplies and men for the development of the newly discovered lead and silver prospects owned by W. W. Watterson and others, of Reno, Nevada. Contracts have been let to haul out 2000 tons of high-grade ore by teams to Bonnie Clair station.

NEVADA COUNTY

Grey Eagle—This mine, in Washington district, has been bonded to Chas. A. Marriner and others, who will immediately begin work with 20 men. There is a mill and other necessary machinery on the property.

Iron Clad Mining Company—This mine at Rough & Ready, owned by Plymouth, Ohio, men, is soon to be reopened, and machinery will be contracted for within a month. H. M. Black is superintendent.

Inkmarque—This mine at Nevada City, owned by Rosenfeld's Sons, of San Francisco, is shortly to be started up under lease to local men. The water is to be removed and the shaft retimbered.

PLUMAS COUNTY

Del Monte—J. D. Murray, of Bovard, Nev., has taken an option on this group, owned by John Rickard, and since setting men at work, has uncovered a favorable body of ore.

SAN BERNARDINO COUNTY

Dry Lake—The hoist at this mine, near Victorville, is now in operation, and a small stamp mill will be installed at once. A. A. Preciado is manager.

Sloan—G. F. Sloan has shipped two carloads of $50 ore from his lease on the Jumbo at Hart.

SAN DIEGO COUNTY

Cleveland-Pacific—The mill of this company has commenced crushing ore from the Paling Brothers' lease.

SHASTA COUNTY

Harrison Gulch—At this camp (Knob P. O.) the Victor company has installed a new hoist. The Midas is now down to the 1200 level. Work is shortly to begin on the Connor group of mines.

TRINITY COUNTY

Mary Blaine—At this property, New River, W. E. Sherwood, superintendent, work has been resumed.

Oriole—Eastern men have bonded this mine from Collins Brothers & Paulson, and will soon commence development work.

TUOLUMNE COUNTY

Big Four—At this mine, near Tuolumne, owned by Deming, Wilds & Savor, a strike of importance has been made. The ore is being sacked for shipment to the Selby smelter.

Rawhide—This famous old mine, owned by W. A. Neville, which has been idle for some time, is about to be started up again.

Colorado

GILPIN COUNTY

Black Hills & Denver Gold Mining Company—Ohio people are chiefly interested, and recently they had a meeting and decided to resume operations on their Boulder Park property. L. A. White, Tolland, Colo., is manager.

Dirigo Mining and Milling Company—Southern capitalists are interested in the purchase of the Douglas mill in Wide Awake district, and they are arranging for starting up the Dirigo mine.

Esculapian Gold Mining Company—At a depth of 150 ft. in the Star of the West group an 8-in. streak of gold, silver and copper ore has been opened up. Chicago people are interested, with Stephen Harper as superintendent.

Gilpin-Eldorado Mining Company—Pennsylvanians interested in the Eldorado mine in Spring gulch are arranging for the resumption of work by July.

Grand Union—Eastern and Denver capital is interested on South Boulder creek and will make arrangements at a later date for the installation of a compressor plant. O. Q. Beckworth, Rollinsville, Colo., is manager

Iowa Girl—Sylvanite ore has been found in the tunnel of this property in Moon gulch, and assays run high in gold. W. S. Dexter, Rollinsville, Colo., is manager.

Leavenworth—This property in Russell district has been sold for $50,000 to F. P. Reed, of Denver.

Rockford—S. T. Harris, of Russell Gulch, has taken a lease and option on this mine and is installing machinery for active operations.

Troublesome—Milling ore from 5 to 8 ft. in width has been opened up west of the shaft at a depth of 165 ft., which shows well in gold and makes good concentrates worth $20 to the ton.

West Concrete—Maloney & Co., of Central City, have opened up some wire silver ore yielding high assays, besides some gold and lead.

Winning Mining Company—Denver and Pennsylvania capital has become interested in the organization of this company and in the purchase of the Hall mine in Russell district. A. G. Rummel, Russell Gulch, Colo., is to be manager.

LAKE COUNTY—LEADVILLE

Crecentia—Recently a controlling interest in this property, Rock Hill, was sold to Lou R. Johnston and associates, of Denver. Several improvements are now under way and when completed the underground force will be enlarged and 50 tons daily of low-grade sulphide and iron will be shipped.

Helena—In this mine, Iowa gulch, drifting from the 500-ft. level to the east a good body of lead ore has been encountered, the vein being 4 ft. wide, and as development proceeds it becomes larger; the ore carries 50 per cent. lead, some silver and a trace of gold.

International—The tonnage from this property, Robinson, is on the increase daily and is now close to 100 tons. A great deal of development work has been going on at the different levels and the ore zone has been opened in them all. This is a continuation of the old Robinson vein.

Little Jonny—On this mine, Breece hill, Hahnewald Brothers are leasing on No. 4 shaft at the 1200-ft. level, where they have a large body of sulphide ore. During the week in the center of this body appeared a streak 2 in. wide of ore running very high in gold, and so far they have taken out 300 lb. with the streak still in sight. It appears to be a concentration of the auriferous values in the heart of the sulphide body; the gold is all in the form of wire. The mine is producing in the neighborhood of 7000 tons per month and is employing about 400 men.

South Evans—The Luema Mining Company controls the Valley, Forest Rose and Dispute claims comprising 16 acres of patented ground. A new shaft was sunk on the Valley to a depth of 700 ft., and a good body of sulphide ore opened; the ore zone is being opened and at present daily shipments of 30 tons are being sent to the smelter. Other properties in the gulch, including the Fanny Rawlins, Favorite, Louise, etc., are shipping regularly.

TELLER COUNTY—CRIPPLE CREEK

Prince Albert—This company, owning 26 acres of ground on the extreme southeast slope of Beacon hill, adjoining the Gold Dollar Consolidated, will hereafter work directly the mine, which has heretofore been operated under the leasing system. The deepest shaft on the Prince Albert is only 275 ft., and work has never been done to any extent below the 200-ft. point. John Nicholls, formerly superintendent of the Midget, has been put in charge of the work by Henry Iland, president of the company. There is a vein which is exposed in the gulch which separates Grouse and Beacon hill, and it is proposed to drive an adit on this vein for a distance of 1200 ft. The tunnel will cut the Prince Albert claim at 600 ft. depth.

Republic Gold Mining Company—A two-years' lease, with royalty of 20 per cent. flat on all ores marketed, has been secured on the Beacon hill group of three claims owned by the Republic Gold Mining Company, by Dan Stewart and associates. Work on the Janet W. claim, on which the main shaft is situated, has commenced and development work on an extensive scale is projected. The property, containing about nine acres patented, lies south of El Paso Consolidated.

Idaho

SHOSHONE COUNTY

Tamarack & Chesapeake—Repairs to the compressor, which was damaged some time ago, have been completed and the plant is again in working order. Development will be pushed with as many men as the present power justifies, which means that three machines will be kept busy, and a crew of hand-drillers will be worked besides. A stockholders' meeting was held in Spokane a few days ago at which all the old directors were re-elected.

Hercules—Work is progressing steadily, about 250 men being employed. They are engaged on the second, third and fourth levels. Last month was the record month for the Hercules in ore production; 23,000 tons of ore were shipped, of which 16,000 tons represented concentrates. The ore is going to the East Helena smelter of the American Smelting and Refining Company.

Charles Dickens—More than 2500 tons of ore are now broken down, and the manager estimates that sufficient will be ready by the time the new concentrator is completed to keep the mill running one month. A crew of 25 men is now employed, mostly engaged in breaking ore.

Stewart—A report from Wardner states that this mine is to reopen again. Authority for the statement is not obtainable from the owners, but it is known that the management has been in consultation with the Cœur d'Alene Development Company, upon whose land the mill stands, for a release of injunction which will permit it to run.

Snowstorm—This mine has been forced to close on account of the floods which have prevented handling cars to haul the ore. The bins are full.

Morning—This property, owned by the

Federal Smelting and Refining Company, which opened up less than two weeks ago, is finding difficulty in securing sufficient experienced machine men. Small bodies of men are daily arriving, but the crew does not exceed 125 men. The company intends to put the mine on a full running basis as soon as possible.

Kansas

ZINC-LEAD DISTRICT

Frank Hunt and associates have taken a lease on the old Murphy ground near Galena, and have begun drilling. This ground was drilled years ago, and sheet ore was reported at 250 ft. depth.

Michigan

COPPER

Mohawk—Sinking is in progress in all of the company's five shafts; each shaft, with the exception of No. 5 is equipped with a permanent hoisting plant. No. 5 shaft, the newest of the openings, is to have a new hoisting equipment. A high-duty engine was purchased from the Wolverine mine and will be assembled this summer. Conditions throughout the mine are very satisfactory and rock shipments of from 2000 to 2200 tons daily are being made to the mill.

Wyandot—This company has begun crosscutting eastward from the bottom of its exploratory shaft, which is down about 800 ft. This crosscut will be driven to the sandstone and will cut the various lodes that cross the property.

Copper Range—The shaft on the Globe tract, held under option by this company is down about 1000 ft., and is bottomed in a formation believed to be the Baltic lode, but carrying practically no copper. The shaft encountered this formation at a depth of 980 ft. and will be continued until it cuts through it, when drifting on the vein will be started. Developments in the lateral openings will be watched with interest, as it is upon this that the fate of the tract, as far as this company is concerned, depends.

Franklin—The Franklin, Jr., property is opening the Pewabic lode, by means of crosscuts from the 21st and 23d levels of the Conglomerate shaft.

Seneca—This company is carrying on diamond drill work and a complete cross section of its lands will be obtained. A shaft is also being sunk to open up the Kearsarge lode; this shaft is being sunk 60 ft. from the footwall. As levels are established crosscutting to the lode will be started.

Hancock—No. 1 shaft is sinking below the thirteenth level and at that point a crosscut is being driven to encounter the West lode. Drifts on this lode from the upper levels are showing good rock. No. 2 shaft is down below the 1000-ft. level and is sinking in a very hard formation of conglomerate intermixed with sandstone. During sinking copper has appeared from time to time and one promising amygdaloid formation was passed through. The calculated vertical distance to the West lode from the collar of this shaft is 2000 ft. At the annual meeting of the company, held recently at Hancock, Mich., the old board of directors was re-elected.

Keweenaw—The company is drifting and blocking out ground, sinking being temporarily suspended until such time as the openings are sufficient to keep the mill in operation. A thorough test is to be made on the Medora-shaft rock and the Phœnix mill is to start stamping early next month. This mill is being overhauled and put in first-class working order. Woodbury jigs have been ordered for the concentrating department. The Keweenaw Central railroad has completed its road into Calumet and a regular running schedule is now in effect between there and Mandan, the northern terminus of the line.

Allouez—The crosscut from the sixth level of No. 1 shaft has been holed through to No. 2, thus connecting the two shafts, which is very important for ventilation and affords another passage to and from this shaft. This crosscut intercepted No. 2 shaft at a point 1659 ft. from surface and approximately 700 ft. above the point where No. 2 shaft will cut the vein.

Missouri

ZINC-LEAD DISTRICT

The Oakwood and Carbonate, two large sheet-ground mines near Webb City, have shut down. The Oronogo Circle at Oronogo, a large producer, has also closed.

Endeavor—This company is just completing a 225-ton mill on its lease at Prosperity. It has a 40-acre tract with a 12-ft. face of sheet ore, shown by nine drill holes and two shafts.

McCullogh & Murdock—Two 11-in. lift pumps have been installed on the tract of this company adjoining the Herald mine at Cave Springs. Many other old mines will have to be unwatered before work in the ground can be started.

Newsboy—A company has been organized to reopen this old mine on the Boston-Duenweg tract at Duenweg. H. W. Dale and Martha E. Bennett own the stock. The mine was worked at the 140-ft. level and a large quantity of ore produced. The 180-ft. level will now be worked.

Vantage—This company has started pumping the upper levels of its ground at Webb City. This will not help the other mines in the neighborhood, as the water encountered in the upper levels has no connection with that in lower ones.

Montana

BUTTE DISTRICT

Butte & Superior—A depth of 1200 ft. has been reached on this property. The shaft will be sunk 50 ft. further and a station will then be cut on the 1200 and electric pumps installed, capable of handling 300 gal. of water per minute. While some exploration work will be done on the 1200, it is generally understood that the company intends to sink several hundred feet more, when the greater part of the exploration work will be done.

North Butte Extension—It is expected that this company will soon be able to straighten out financial tangles, and that the property, now closed down, will resume operations. The shaft is down 600 ft. Some time ago an electric pump of large capacity was ordered for the 1000 level, with the expectation that the shaft would be sunk to a depth of at least 1500 feet.

British-Butte—The early part of this week the company instituted suit against E. D. Moore, alleging that the defendant had attempted to re-locate its Jessie placer claim. The action is brought to secure an injunction against the attempted re-location proceedings and to quiet title to the company's ground.

MISSOULA COUNTY

Amador Mining Company—Some weeks ago the experts sent out to examine the company's properties published an unfavorable report. At a recent meeting, attended by a number of the stockholders, some dissatisfaction was expressed with the report and steps have been taken to secure the services of another engineer to make a further report.

Nevada

ESMERALDA COUNTY—GOLDFIELD

Output—Production for the week ending June 23 varied little from that of last week; it was handled as follows: Combination mill, 640 tons, value $19,200; Nevada Goldfield Reduction Company, 636 tons, $63,600; Western Ore Purchasing Company, 874 tons, $96,140; total, 215 tons, value, $178,940. The producers were: Consolidated, 704 tons; Jumbo, 358 tons; Engineers' Lease, 28 tons; Mushett Lease, 26 tons; Sandstorm No. 5, 15 tons; Knickerbocker Lease, 20 tons; Hayes Curtis, 55 tons; Ellsworth-Baumgartner Lease, 6 tons, $1090 per ton; Combination Fraction, 87 tons; Mohawk, 40 tons; Rogers Syndicate, 403 tons; Mohawk Combination, 156 tons; Byers Sandstorm Lease, 4 tons; Little Florence, 40 tons; Van Riper-Mohawk, 183 tons; Parkinson-Victor Lease, 24 tons. In addition 39 tons of $75-ore were received from the Great Western at Hornsilver.

Mohawk Combination—Final returns for the four days run of this lease, the

time allowed to it by the board of arbitrators, shows 742 tons of an average value of $90.40, equivalent to a total of $67,077, or a daily production of $16,769.

Rogers Syndicate—This lease on the famous Florence has paid its seventh dividend of $30,000, bringing the total paid since March 28 to $215,600. Two days' output from this lease for which settlements were received last week amounted to $35,750.

Jumbo Annex Lease—A cave has occurred in these workings which runs to surface and is so near the Bullfrog railroad that traffic may be held up temporarily.

Commonwealth—This strike is proving up well; 60 tons of $60- to $70-ore are in chutes awaiting hauling to the mill.

Codd-St. Ives Lease—A pump will be installed to take care of the water on the 500-ft. level where good showings have been encountered.

Gem-Florence—A six months' extension has been granted this lease.

Elk Consolidated Leasing—This company, operating on the Yellow Tiger, will continue its shaft from the 600-ft. level, where a large body of mill ore has been proved to the 900-ft. level.

ESMERALDA COUNTY—HORNSILVER

The mine owners and operators have given notice that beginning July 1 the Tonopah wage scale of $4 and $4.50 will be adopted. If any opposition is shown by the union men the operators will declare the camp open and enforce the scale.

Frances Lime Point Mining Company—This company operating the Murray & Robinson property will make another shipment by the teams which are to haul its hoisting machinery from Goldfield.

Great Western—Both the east and west drifts on the 200-ft. level encountered new orebodies last week which are reported very high grade. Ore is being sacked from the 100-ft. level.

Great Eastern—This property, which lies two miles southeast of Hornsilver, has a 4-in. streak of jaspery quartz which runs almost $1000 per ton. This is the kind of stuff the "old chloriders"' packed 300 miles to Candelaria 40 years ago.

GOLD MOUNTAIN DISTRICT

Nevada Empire—All the material for the mill at Gold Mountain has been shipped and construction will begin as soon as it arrives.

North Star—Lessees on this claim of the Keystone Mining Company have 250 sacks of $50 ore on the dump ready to ship.

Nevada Empress—All the lumber and other building material for the Nevada Empress mill is either at the mill site or at the railroad at Cuprite awaiting teams. The machinery has all been shipped and will be on the ground as soon as it can be used. An aërial tramway will probably be built to convey the ore from the upper tunnels to the mill.

NYE COUNTY—LODI

Lodi, situated 30 miles southeast of Fairview, 45 miles east of Luning and 60 miles west of Austin, is to have a smeltery. The contest between the Lodi Mines company and the Lodi Townsite company has been settled by giving four-fifths of the water right to the Mines company and one-fifth to the Townsite company. A 100-ton water-jacket furnace will be installed. The machinery will be hauled from Luning, the railroad point, by two traction engines which will subsequently haul ore to the plant.

NYE COUNTY—TONOPAH

Belmont—One of the most important discoveries in the history of Tonopah was made this week when pay ore was found on the 1000-ft. level on the north side of the Mizpah fault. Thus far all the known veins on Oddie mountain have been cut on their east trend by the Mizpah fault which strikes northeast and southwest and it has been commonly predicted by mining engineers that no ore would be found north of this fault line. This fault material has been crosscut for nearly 200 ft. It consists of country rock and quartz. On the north or hanging wall side of the fault 3 ft. of quartz was encountered which carries benches of high-grade ore. Development work is now being watched with great interest by both the Belmont company and local mining men in general.

NYE COUNTY—ROUND MOUNTAIN

By automobile to Goldfield was brought one day last week $12,000, the clean up from a 15-days' run at the Round Mountain mill and $6000 the result of a week's work by the Round Mountain Hydraulic Mining Company. The former company has distributed $32,000, its first quarterly dividend. The latter company is operating three giants on the Sunnyside and Great Western properties. Operations at one of these points have uncovered a quartz ledge from 20 to 40 ft. in width eight samples from which assayed from $4 to $56 per ton.

SEVEN TROUGHS

Mazuma Hills—The Mazuma Hills mill has just made a 10-day clean-up amounting to $20,000. This was from a run on high-grade ore and the results are so satisfactory that the company will treat all its own ore hereafter.

Seven Troughs Kindergarten Mining Company—The mill of this company known as the Kindergarten or Friedman mill has been running continuously for nearly a month and is giving good satisfaction.

Seven Troughs Mining Company—Work has been started sinking the company's shaft from the present 525-ft. point to the 1000-ft. level.

Ohio

The State Mining Department, through George Harrison, chief inspector of mines, on June 24, issued the following important notice, addressed to all mine operators, mine superintendents and mine bosses, operating or having charge of mines in Ohio:

"On and after July 1, 1908, all mining machine cuttings, or what is known as 'bug dust,' must be sent out of the mine, and no portion of it can be thrown back in any room or working place or used as ballast on any track or haulway in any part of the mine.

"The law requires that in any entry or airway in any mine which becomes so dry that the volume of air is liable to become charged with dust, that whoever is operating said mine as owner, lessee, agent, or in any capacity, shall have such entry or airway thoroughly sprayed and sprinkled with water, or cleaned in such a manner that the air will not become charged with dust. The same law makes it imperative that the inspector must not allow an accumulation of dust in any mine. The specific penalty for failure to comply with this provision of the mining law is a fine of from $200 to $500 in each conviction.

"Notice is hereby given that every mine inspector will prosecute to the fullest extent every case of violation coming to his attention on and after the above named date."

Oregon

BAKER COUNTY

Hidalgo—The vein in this mine, near Sumpter, has been cut in the adit driven by Tompkins Brothers, the owners. The face of the adit is now 900 ft. from the entrance and about 300 ft. below the surface.

Quebec—Negotiations are in progress for the reopening of this mine near Sumpter. A good deal of development work was done on it several years ago.

Pennsylvania

ANTHRACITE COAL

For the past week the Lackawanna county court has been taking testimony on the appeals of the Delaware, Lackawanna & Western, the Delaware & Hudson and other coal companies from the assessments placed upon their property by the county commissioners. The county board employed engineers to put a value on coal lands, and these experts estimated the quantity of coal unmined and valued it at $100 per foot-acre. There is no serious difference as to the extent of the coal, the appeals being taken chiefly on the valuation. It is understood that the companies are willing to abide by the decision of the court. A large number of

experts have testified on both sides, but their estimates of the value of coal in the ground differ very widely.

Pine Knot Colliery—Regular mining operations were started at this colliery at Coal Castle on June 29. Development and construction have been going on for some time, and the mine is one of the largest in the anthracite region. It is expected to ship 3500 tons a day. It is owned by the Philadelphia & Reading Coal and Iron Company.

BITUMINOUS COAL

Pittsburg-Buffalo Coal Company—This company is rushing work on its new plant at Marianna in the Pittsburg district. Three shafts have been sunk, and coal is being produced on a small scale. A contract was awarded June 22 for a 550-kw. generator with a Reynolds-Corliss engine to drive it. This is the first of six great generators to operate the plant. The company has built 50 houses for miners, and on June 22 let a contract for 50 more, and the number will be increased by 150 additional houses before the end of summer. All these houses are to be of brick construction, and each will contain a bath room, an innovation in miners' dwellings.

South Dakota

LAWRENCE COUNTY

American Eagle—President Geo. A. Code, of Minneapolis, has taken full charge of the property in Bald Mountain. General manager Goldbloom and J. E. Downs, the mill constructor, have resigned.

Ama Queen—Work has started again with the Sherman boys doing considerable development. Ore is to be hauled to the Custer Peak company's mill.

Utah

JUAB COUNTY

Tintic Shipments—The mines of this district shipped 66 carloads this week, as follows: Centennial Eureka, 39; Eureka Hill, 6; May Day, 6; Uncle Sam Consolidated, 6; Carisa, 1; Mammoth, 3; Grand Central, 3; Yankee Consolidated, 2; May Day (concentrates), 2 cars.

Sioux Consolidated—The initial shipment of ore from this mine netted $3860 for 35 tons.

SUMMIT COUNTY

Park City Shipments—The mines of this camp shipped last week 846 tons, as follows: Daly Judge, 286; Silver King, 350; Daly West, 200 tons.

Washington

OKANOGAN COUNTY

Night Hawk—A new concentrator is now being installed at this mine and it is expected that it will be in operation within a few weeks. The mine has shipped much ore in the past, but owing to long distances and high freight has been compelled to equip for local treatment.

Ruby—Manager Harman has gone East to confer with stockholders with a view, it is stated, of securing funds and permission to erect a reduction plant at the mine, situated near Loomis. The Ruby contains principally silver ore, some being rich ruby silver, but the excessive freight rates to the Tacoma smelter, where it is treated, are too great a drain, and much of it cannot stand shipment. The mine is well developed with adits and upraises, and a large quantity of valuable ore is on the dumps. Several cars were shipped to the smelter early in the spring, but this is to be discontinued.

Wisconsin

ZINC-LEAD DISTRICT

A new corporation, with a capital of $1,000,000, has been formed to take over the new pyritic separating plant and the leading Platteville mines, including the Empire, Acme, Enterprise and probably the Hodge. The new company is backed by the Platteville Separator people.

Calvert—In this mine at Benton the shaft has been completed at the oil rock at 112 ft. depth, and drifting has been begun. The orebody is showing up a strong sheet formation, with a 10 o'clock course. It seems to be the west pitch of the Frontier mine.

Dawson—This mine at Benton has been started up by Chicago people, who bought out the local interests.

Fox—This mine at Hazel Green has opened up richer ground, and has developed into one of the large shippers of the district.

Frontier—This mine at Benton has settled down to a weekly production of about 150 tons of concentrates; the mill is running one shift, milling 700 to 800 tons of rock weekly. In spite of heavy water and low prices of ore, the operators are said to be netting $1600 to $1800 weekly, after paying 10 per cent. royalty.

Kennedy—At this mine, Hazel Green, a second mill is being erected. It is in the gulch west of the old mill, where there is more room for the tailings.

Scrabble Creek—The shaft at this mine is being unwatered. This shaft will also be used by the new Cleveland Mining Company, until its mill is erected.

Canada

ONTARIO—COBALT DISTRICT

Ore Shipments—Shipments of ore for the week ending June 20 were as follows: La Rose, 104,670 lb.; McKinley-Darragh, 60,000; Nipissing, 239,880; O'Brien, 128,120; Trethewey, 65,670. Total, 598,340 pounds.

Cochrane—This property lies directly south of the Temiskaming, and it is believed that one of the rich veins of the latter crosses it diagonally. Work was started last year, but was suspended on account of the miners' strike. Operations are now being resumed under direction of Floyd Harmon, formerly superintendent of the Temiskaming. A first-class plant will be installed.

La Rose—A discovery has been made at the depth of 35 ft. and 60 ft. southwest of the main shaft. A blind vein of rich ore 20 in. wide in places and running parallel to the main vein was disclosed. The value of the find is confirmed by W. E. Hidden, who was at the mine when the vein was encountered.

Lawson—Work has been resumed and the old shaft, which was down 40 ft. is being sunk deeper. A crosscut will be run at the 40-ft. level.

Nipissing—The company has a force of 302 men employed in mining and prospecting, and is working to reach the new find on the Kendall vein struck recently by diamond drill. It is expected that this will be effected in about 10 weeks. About $15,000 worth of silver per week is now being mined.

ONTARIO—HASTINGS COUNTY

Big Dipper—A thorough test has been made of this gold property which belongs to a Buffalo syndicate, resulting in the installation of a 10-stamp mill.

Golden Fleece—Hastings county, Ont., This gold mine in Kaladar township was purchased recently by a New York syndicate and operations are being steadily carried on. A 10-stamp mill is working and the output is satisfactory.

NOVA SCOTIA

Dominion Iron and Steel Company—The annual meeting of the shareholders was held in Montreal June 25. President J. H. Plummer put before them the terms of settlement of the dispute with the Dominion Coal Company as proposed by the latter company. The basis of settlement suggested was that the case before the Imperial Privy Council should go on, but that the results of the appeal should be limited by an arrangement in advance of the decision. It was proposed that should the coal company succeed it must give $1,250,000 to the steel company, whereas if the steel company should be successful it should not receive more than $2,000,000 damages. An alternative proposal fixed these amounts at $1,500,000 and $1,750,000, respectively. In either case the price for coal hereafter is to be $1.50 per ton for slack and $1.80 for run-of-mine, adjustable yearly, the coal company guaranteeing to supply 25 per cent. in slack. The proposals were unanimously rejected. A resolution was adopted authorizing the directors to increase the common stock by $5,000,000, and to issue $20,000,000 consolidated bonds to retire the outstanding bond issue, and provide for the floating debt, improvements and extensions.

SASKATCHEWAN

Lac Laronge Copperfield—The rush to this district continues, eight outfits having

left Prince Albert, Sask., on June 24. A stage road is to be opened to Montreal Lake, 75 miles further north.

YUKON TERRITORY

Yukon Gold Company—A large consignment comprising 31 carloads of steel pipe for the hydraulic plant is on the way to Dawson by the White Pass & Yukon railway. This pipe was made in Germany on a special design and is 44 in. in diameter in 30-ft. sections, each section weighing 5 tons. It is for use in the inverted siphon crossing the Klondike river two miles above Dawson, and when put in place will complete the line. The pipe is the first of its kind to be used in mining operations in the Territory.

Mexico

CHIHUAHUA

Piedras Verdes—R. S. Towne has bought from the estate of Buenaventura Becera, of Urique, the Piedras Verdes mines, which he has held under option for about two years, and which are located about five miles north of the surveyed line of the Kansas City, Mexico & Orient Railway, in western Chihuahua and near the Cieneguita district of Sonora.

Promontorio—The Promontorio mine, in the Cusihuiriachic District, owned by Delgado & Barcenas, which is now under lease and bond to Los Angeles capital, is now being examined by R. B. McGinnis, of San Francisco, for the Los Angeles people who are sinking the shaft several hundred feet deeper.

Ojinaga—The third well of the Hearst-Keene syndicate, in the Ojinaga district of eastern Chihuahua, has struck oil at 700 ft., but will be continued to a depth of 3000 ft. with the hope of striking a heavier flow of oil.

COAHUILA

Jimulco Mining Company—This company, owning large copper mines east of Jimulco in the State of Coahuila, which has been closed down since last fall, was opened up again on the first of June by A. L. Tuttle with 150 men. The same company owns the Panuco copper mines, in the northern part of Coahuila, where experiments are being made for concentrating the ores.

FEDERAL DISTRICT

The new bill providing for the paving of 50 or more streets in Mexico City with asphalt specifies that the material shall come from the Mexican asphalt fields at Ebano, State of Vera Cruz.

GUERRERO

Maine & Nebraska Mining Company—This company has obtained a concession to build a railroad from its mines to connect with the Balsas river branch of the Mexican Central Railroad; the construction work will begin in July.

JALISCO

San Sebastian—The Navidad Mines and Reduction Company, of Berkeley, Cal., operating near San Sebastian, in the State of Jalisco, is receiving and erecting the tanks for its 200-ton cyanide plant.

OAXACA

Taviche—The San Juan de Taviche Railroad Company has been organized to take over and push to completion the road from Taviche to Ejutla. It is believed the road will be completed this year.

SONORA

Lucky Tiger—The Lucky Tiger Gold Mining Company, famous by reason of a long drawn out litigation, has greatly increased its operations, having now about 300 men employed, and producing at the rate of more than $100,000, Mexican, per month, with close to $25,000, Mexican, profit per month.

Moctezuma Copper Company—One-half of the new 2000-ton capacity concentrator, Nacozari, is completed and in operation. The concentrator is in two units of 1000 tons capacity each. The second half will be completed in about two weeks. The old concentrator of 700 tons capacity is still being operated, which brings the amount of ore treated per day up to approximately 1500 tons. In the new plant, several departures from the regular milling methods have been made, and all are apparently successful. The new power plant is also in operation.

Cananea-Duluth—In this mine of the Greene-Cananea company, Cananea, on the 300 level large quantities of ore are continually being opened up. The ore averages about 4 per cent. copper and 8 oz. silver.

Democrata Mining Company—Since the shutdown of this company's smeltery several months ago, considerable development work has been done in the mine. At present there are seven machines in operation, all on development work.

Sierra de Cobre—This property, which is one of the Phelps-Dodge interests adjoining the property of the Greene-Cananea company, is practically shut down. Pumping is being done from the 500-ft. level, and two prospect drifts are being run by contract on the same level. Nothing is given out as to when operations will be resumed.

VERA CRUZ

Huasteca Oil—The Huasteca Petroleum Company has obtained a concession from the Federal government for the exploration and exploitation of petroleum products and mineral oils on the company"s land in the Huasteca district in the northern part of the State of Vera Cruz, bordering on the States of San Luis Potosi and Tamaulipas, and in return for this concession has obligated itself to spend $500,000 in five years, construct pipe lines, build the necessary railway, and organize as a Mexican company under the country's laws.

ZACATECAS

Mazapil—The company made a material reduction in wages on June 1 because of the continued low price of the metals, and trouble was averted by the presence of Federal troops.

Europe

SPAIN

Exports of metals from Spain for the four months ended April 30 are reported by the *Revista Minera* as follows, in metric tons:

	1907.	1908.	Changes.
Pig and manu. iron	19,611	6,777	D. 12,834
Copper	2,793	3,824	I. 1,031
Copper precipitate	5,707	8,245	I. 2,538
Spelter	398	404	I. 6
Lead	63,820	61,848	D. 1,972
Quicksilver	1,036	848	D. 188

Exports of sulphur were 3 tons only. Exports of ores and minerals were as follows:

	1907.	1908.	Changes.
Iron ore	3,234,360	2,769,930	D. 464,430
Copper ore	487,225	405,153	D. 82,072
Zinc ore	63,512	36,593	D. 26,919
Lead ore	2,044	1,221	D. 823
Manganese ore	27,329	9,501	D. 17,828
Pyrites	434,320	498,971	I. 62,651
Salt	165,024	220,116	I. 55,092

Imports of sulphur this year were 4037 tons. Imports of phosphates and of basic slag for fertilizers were 31,133 tons:

Africa

WEST AFRICA

Gold production in May is reported at 24,227 oz. bullion, which is 881 oz. less than in April, and 1085 oz. less than in May, 1907. For the five months ended May 31 the total was 122,344 oz. bullion in 1907, and 126,259 in 1908; an increase of 3915 oz. The bullion reported this year was equal to $2,454,299, or 118,737 oz. fine gold.

Australia

QUEENSLAND

The Mines Department has reported the production of metals and minerals, other than gold and coal, for the quarter ended March 31, 1908. The production of metals was as follows, the figures in parentheses being the outputs for the corresponding quarter of 1907: Silver, 203,344 oz. (177,704 oz. in 1907); copper, 2754 tons (2602); tin, 1246 tons (1318); lead, 1382 tons (865). Of the tin 372 tons were alluvial and 874 tons lode tin.

The production of ores was: Manganese ore, 330 tons (125); iron ore, 59 tons (717); antimony ore, 7 tons (210); wolfram ore, 73 tons (98); bismuth ore, 6 cwt.; bismuth-wolfram ore, 11 tons (5); molybdenite 3.5 tons (8.25). The limestone quarried as flux was 31,666 tons, an increase of 26,092 tons over last year.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, July 1—The coal trade in the West shows no material change, the light demand for steam coal continuing to be manifest everywhere. The Lake trade has begun to move, which will improve matters a little. The only increase in business reported is from the Pittsburg district.

In the East also bituminous trade is dull almost everywhere. Steam coal is in light demand and consumers are hesitating about putting in stocks ahead. The anthracite trade, which has hitherto kept up fairly well, is falling off and shows marked signs of dulness.

COAL TRAFFIC NOTES

Tonnage originating on Pennsylvania Railroad lines east of Pittsburg and Erie, year to June 20, in short tons:

	1907.	1908.	Changes.
Anthracite.....	2,698,724	2,575,880	D. 122,844
Bituminous.....	17,955,624	15,069,890	D. 2,885,734
Coke.....	6,690,937	3,177,490	D. 3,513,447
Total.....	27,345,285	20,823,260	D. 6,522,025

Total decrease this year to date was 23.9 per cent.

Coal tonnage reported by Southwestern Interstate Coal Operators' Association, three months ended March 31, short tons:

	1907.	1908.	Changes.
Missouri.....	714,658	867,528	I. 152,870
Kansas.....	1,623,315	1,876,956	I. 253,641
Arkansas.....	575,101	670,330	I. 95,229
Oklahoma.....	722,402	877,568	I. 155,166
Total.....	3,635,476	4,292,382	I. 656,906

The total increase this year was 18.1 per cent.

New York

ANTHRACITE

July 1—Both prepared and small steam sizes are inactive and the market is very dull. The Lake traffic is at present very light, but it is believed that with the arrival of ore shipments this month the traffic up the Lakes will begin in earnest. Price cutting is general, in some cases as much as 20c. per ton for prepared sizes. The discount on tidewater prices is reduced 10c. today.

Prices are as follows: Broken, $4.55; egg, stove and chestnut, $4.80; pea, $3.25@3.50; buckwheat No. 1, $2.35@2.50; buckwheat No. 2 or rice, $1.60@2; barley, $1.35@1.50; all f.o.b. New York harbor.

BITUMINOUS

If there is any improvement in the soft-coal market it is very slight indeed. In the far East a few consumers are taking on coal, but an indifference prevails throughout the trade and business is extremely light.

Transportation from mines to tide takes about a week. In the Coastwise vessel trade there is a shortage of small craft in Philadelphia, but not in New York harbor. Vessel captains seem to be willing to charter in order that they may get home to tie up. Freight rates are as follows from Philadelphia: To Boston, Salem and Portland, 50@55c.; Lynn, 55@60c.; Newburyport, 75c.; Portsmouth, 55@60c.; Saco, 90c.; Bath, 60@65c.; Gardiner, 65c.; Bangor, 70@75c.; to the Sound, 45@50c.; towages where usual.

Birmingham

June 29—Considerable interest is still manifested in what the commercial coal operators of Alabama will do July 1, when the contract with the union miners expires. The commercial operators are the only interests in the State who recognize the union and they have demanded of the miners the same wage contract as exists at the non-union mines, in order that the competition can be met. There are less than 4000 union miners in Alabama at present. There is a large quantity of coal being mined just at present and the demand is good. Several old mines will resume operation during July, while two or three new mines are to be started.

Chicago

June 30—Summer business runs more and more to fine coals, with lump suffering. Domestic coals are weak and should be kept out of this market for a while. Eastern coals are a good deal troubled with demurrage, and bring cut prices. Illinois and Indiana screenings and the lower-priced run-of-mine coals get the business.

Lump and egg from Illinois and Indiana bring $1.75@2 for most sales; $1.65@1.85 for run-of-mine, and $1.50@1.65 for screenings. Brazil block is dull at $2.10 @2.20.

Smokeless run-of-mine is in light demand, but with large receipts, and smokeless lump and egg have very light sales. Hocking is selling under circular price, and Youghiogheny has little movement except on contracts. Anthracite has been dull, the end of June discount bringing only light orders.

Indianapolis

June 29—The recent unexpected advance in the retail price of coal and coke of 25 to 50c. a ton is explained by the dealers to be due to a corresponding advance made by the operators on account of the increased cost of mining, due to the absence of demand for steam or mine-run coal, and the necessity of supplying domestic coal alone.

There is a marked decrease in the number of idle coal cars on the coal carrying roads, and this has given rise to the belief that the retail yards are stocking up. This belief is strengthened by the increased demand at the mines.

Pittsburg

June 30—There is no material change in the coal situation. Nearly all the railroad mines are in operation and the product is going to Lake ports for the northwestern trade. While the demand is light, prices are being maintained on the basis of $1.15 a ton for mine-run coal at mine. Slack has been quoted for several weeks at around 75c., but sales have been made during the week as low as 40c. All the river mines are running and a large tonnage has accumulated in the pools and harbor.

Connellsville Coke—No particular improvement is noted. Not more than one-third of the 37,000 ovens in the Connellsville regions are in operation, but preparations are being made to put some additional ovens in blast. It has been discovered that many coke workers have left the region and operators will have difficulty in securing a sufficient number of workmen when business revives. The *Courier* in its summary for the week gives the production in both fields at 162,404 tons. The shipments were 6355 cars as follows: To Pittsburg, 2522; to points west of Connellsville, 3412; to points east of Connellsville, 418 cers.

Foreign Coal Trade

Nova Scotia coal shipments, by companies, five months ended May 31, long tons:

	1907.	1908.	Changes.
Dominion.....	999,736	1,122,516	I. 122,780
N. S. Steel.....	163,627	223,495	I. 59,868
Cumberland.....	142,220	169,238	I. 27,018
Acadia.....	112,255	131,898	I. 19,643
Inverness.....	109,553	112,678	I. 3,125
Total.....	1,527,391	1,759,825	I. 232,434

Total increase in shipments this year was 15.2 per cent.

Imports of coal into Spain for the four months ended April 30 were 625,473 metric tons, a decrease of 72,976 tons

from last year. Imports of coke were 116,616 tons, an increase of 34,958 tons.

Welsh Coal Trade—Messrs. Hull, Blyth & Co., London and Cardiff, report current prices at Welsh ports as follows, under date of June 20: Best Welsh steam, $3.90; seconds, $3.66; thirds, $3.54; dry coals, $3.84; best Monmouthshire, $3.36; seconds, $3.30; best small steam, $2.28; seconds, $2.10. All per long ton, f.o.b. shipping port.

Iron Trade Review

New York, July 1—The iron and steel markets continue dull, but little new business coming forward. Buyers do not feel any confidence in the present steel quotations; the concessions made were sufficient to induce a hope of further cutting, and little will probably be done until that point is settled. The only considerable sales have been of bars; structural steel coming next in activity, but very far behind. For other material, the market is in a waiting condition.

There has been some business in pig iron. Foundries are not fully supplied yet, and there has been some call for basic pig. A large contract for Alabama basic for second-half delivery is reported made in the West.

Iron and Steel Exports—Exports of iron and steel, including machinery, from the United States for April, and the four months ended April 30, are valued as below by the Bureau of Statistics of the Department of Commerce and Labor:

	1907.	1908.	Changes.
April	$17,684,863	$15,467,319	D.$2,217,544
Four months	62,371,457	58,346,306	D. 4,025,151

Leading items of export for the four months, in long tons:

	1907.	1908.	Changes.
Pig Iron	28,346	11,903	D. 16,443
Billets, ingots & blooms	39,728	54,327	I. 14,599
Bars	30,186	19,632	D. 10,554
Rails	113,005	56,240	D. 56,765
Sheets and plates	45,279	31,620	D. 13,659
Structural steel	44,390	47,280	I. 2,890
Wire	2,881	49,376	D. 3,505
Nails and spikes	19,660	15,735	D. 3,925

There were increases in billets and in structural steel, with decreases in all other items.

Iron and Steel Imports—Imports of iron and steel, including machinery, into the United States for April and the four months ended April 30 are valued as follows:

	1907.	1908.	Changes.
April	$3,723,176	$1,633,812	D. $2,089,364
Four months	13,742,284	7,094,903	D. 6,647,381

Leading items of imports for the four months, in long tons:

	1907.	1908.	Changes.
Pig iron	215,983	39,235	D. 176,748
Scrap	5,461	1,621	D. 3,840
Ingots, blooms, etc.	5,427	3,039	D. 2,388
Bars	9,601	10,757	I. 1,156
Wire-rods	5,666	3,798	D. 1,868
Tin-plates	19,117	21,637	I. 2,520

There were decreases in all items except bars and tinplates.

Iron Ore Movement—Exports and imports of iron ore in the United States for the four months ended April 30, are reported as follows, in long tons:

	1907.	1908.	Changes.
Exports	1,752	30,459	I. 28,701
Imports	402,501	256,973	D. 145,528

Imports of manganese ore were 59,345 tons in 1907, and 73,626 in 1908; an increase of 14,281 tons.

Baltimore

June 30—Exports for the week included 991 tons steel billets and 536,571 lb. galvanized sheets to Liverpool. There was also exported 2,316,856 lb. tin scrap to Rotterdam.

Birmingham

June 29—Southern pig-iron producers report conditions fairly good. Sales have not been as active as during the first part of the month but almost all of the producers have booked orders for at least twice as much iron as they can make during July. The Republic Iron and Steel Company will blow in its third furnace at Thomas this week. Williamson furnace, in Birmingham proper, recently leased by a former employee of the Tennessee company, is to be blown in. There is a healthy shipment of pig iron from this section while the home consumption is increasing. The cast-iron pipe concerns are busy. The machine shops and foundries are doing a little better.

Pig-iron quotations are strong between $12 and $12.50 per ton, No. 2 foundry, the better part of the iron now selling bringing in between $12.25 and $12.50. But little iron is being shipped out from this district for export. The Tennessee company has all its furnaces, with but one or two exceptions, on basic iron. Besides iron for the Ensley steel plant an order for something like 85,000 tons of basic pig has been accepted. There is a little demand again for charcoal iron, which sells at $22 per ton.

Chicago

June 30—Sales of pig iron have not been heavy in the last week but have been well distributed. The market is not so strong as a week or two ago and the feeling of melters seems to be that another sag is possible. Furnace agents uphold the view that with the usual July dullness passed there will be a steady tendency upward in prices and consumption. With sales running from carload lots to 500 tons, buying is again coming to closer deliveries but a certain amount of contract iron for fourth-quarter needs is being sold.

No. 2 Southern foundry is selling for $12@12.50 Birmingham ($16.35@16.85 Chicago) and Northern No. 2 for $17@17.50. The lower prices probably obtain more generally than furnace representatives are willing to admit.

Iron and steel products are not moving briskly in any line. Coke is quiet at $4.90 for the best Connellsville, with contract buying somewhat larger.

Cleveland

June 30—The outlook on Lake freights is not at all promising. Some season charters have been made for ore on a basis of 70c. from Duluth or Superior, which is 5c. less than last season. As low as 65c. is said to have been accepted. The large ore companies, however, have hardly enough for their own boats. In the coal trade there is some demand for small vessels, but they are not coming forward. Rates are 30c. to the head of the Lakes, and 40c. to Lake Michigan points.

Philadelphia

Philadelphia, July 1—The last week of the half year was particularly devoid of features in pig iron. The vacation period has already set in and many heads of offices are absent for the summer. There have been no inquiries of consequence this week. Negotiations were opened two or three weeks ago between two consumers in this territory and Alabama makers, but they have fallen through. The forge-iron furnaces are doing next to nothing. No. 2X foundry may be quoted $16 at furnace.

Steel Billets—No important transactions have grown out of the reduction in billets.

Bars—The recent concessions have not stimulated business. The usual quotation is 1.40c., which in some cases is understood to mean the delivery price. The small mills run regularly so far as they do run. Consumers generally are out of iron.

Sheets—The conditions which have prevailed for several weeks continue, and very little change is probable before autumn.

Old Material—Heavy steel scrap continues in the lead, and all other kinds are dragging.

Pittsburg

June 30—The close of the second quarter finds conditions in the iron and steel trade duller than at any time since the opening of the year. There is no new business of any consequence going in any of the finished lines or in pig iron. All the plants of the Republic Iron and Steel Company will close at midnight tonight and no date has been fixed for resumption. The company operates one large steel plant on a non-union basis, but its 11 iron plants have been for years governed by the annual wage scale of the Amalgamated Association of Iron, Steel and Tin Workers. This year the company refused to make a settlement with the Amalgamated, except under terms that the men would not accept. If the company attempts to operate its iron mills on a non-union basis the officers of

the workers' organization promise a stiff fight. The independent iron mills in the Pittsburg district are running about as usual and will continue. The Western Bar Iron Association, which includes the independent concerns, has a continuous agreement with the Amalgamated Association which permits the plants to operate under the present scale pending negotiations. A conference will be held in Detroit on July 7. The Homestead works of the Carnegie Steel Company are running nearly to capacity and its other mills in this district are in satisfactory operation.

The wage conference between the American Sheet and Tin Plate Company and the Amalgamated Association closed last night with a settlement. The reduction in the tinplate scale is less than 5 per cent. The cut in sheets averages about 2 per cent.

Pig Iron—The largest sale of pig iron noted this week was 200 tons of off-bessemer iron which went at $15.75, Valley. There were a number of sales of carload lots. Prices for delivery during the second half are as follows: Standard bessemer, $16@16.25; malleable bessemer, basic and No. 2 foundry, $15.25@15.50; gray forge, $14@14.25, all at Valley furnaces.

Steel—Billets are $25, Pittsburg, but there is no buying. Plates are 1.60c. and steel bars, 1.40c.

Sheets—The market is fairly active for a dull period. Prices remain at 2.50c. for black and 3.55c. for galvanized sheets, No. 28 gage.

Ferro-Manganese—A few sales for prompt shipment have been made at $46@46.50; for later delivery $1 a ton more is quoted.

Foreign Iron Trade

British Iron Trade—Exports of iron and steel and their products from Great Britain for the five months ended May 31 valued by Board of Trade returns as follows:

	1907.	1908.	Changes.
Iron and Steel.	£19,965,386	£16,462,713	D. £3,502,673
Machinery.....	8,867,620	9,473,629	I. 606,009
New Ships.....	4,689,095	3,908,026	D. 781,069
Total	£33,522,101	£29,844,368	D. £3,677,733

The total quantity of iron and steel was 2,300,322 long tons in 1907 and 1,791,023 in 1908; decrease, 509,309 tons. Exports of pig iron to the United States were 16,811 tons, a decrease of 245,458 tons; of tinplates, 29,722 tons, an increase of 1290 tons.

Imports of iron and steel, and of machinery into Great Britain for the five months were:

	1907.	1908.	Changes.
Iron and steel.	£ 2,691,815	£ 3,051,828	I.£ 360,013
Machinery....	1,767,894	2,325,380	I. 557,486
Total.....	£ 4,459,709	£ 5,377,208	I.£ 917,499

The total quantities of iron and steel were 342,366 tons in 1907, and 420,887 in 1908; an increase of 78,521 tons.

Imports of iron ores into Great Britain for the five months were 3,302,695 tons in 1907, and 2,402,147 in 1908; a decrease of 900,548 tons. Of the 1908 imports, 1,794,038 tons were from Spain.

Metal Market

Gold and Silver Exports and Imports

NEW YORK, July 1.

At all U. S. Ports in May and year.

Metal.	Exports.	Imports.	Excess.
Gold:			
May 1908..	$26,555,913	$ 3,069,402	Exp. $23,486,511
" 1907..	4,505,444	2,682,163	" 1,823,281
Year 1908..	44,891,257	22,926,623	" 21,964,634
" 1907..	12,428,592	19,303,305	Imp. 6,874,713
Silver:			
May 1908..	4,028,334	3,362,176	Exp. 666,158
" 1907..	4,326,216	3,563,096	" 763,120
Year 1908..	21,077,185	17,660,758	" 3,416,427
" 1907..	23,858,610	18,919,065	" 4,939,545

Exports from the port of New York, week ended June 27: Gold, $79,810, chiefly to the West Indies; silver, $990,054, to London and Paris. Imports: Gold, $135,485, from Central and South America; silver, $13,752, from Mexico.

Specie holdings of the leading banks of the world June 27, are reported, as below, in dollars:

	Gold.	Silver.	Total.
Ass'd New York	.....	....	$316,670,200
England.....	$197,023,065	.....	197,023,065
France..... ..	630,278,435	$189,219,505	819,497,940
Germany.....	200,290,000	83,005,000	283,295,000
Spain.....	78,050,000	134,250,000	212,300,000
Netherlands....	38,515,500	21,327,000	59,842,500
Belgium.....	20,753,335	10,376,665	31,130,000
Italy.....	181,160,000	21,500,000	202,660,000
Russia.....	559,135,000	38,255,000	597,390,000
Aust.-Hungary.	234,000,000	66,695,000	300,695,000
Sweden.....	19,430,000	.....	19,430,000
Norway.....	7,265,000	.....	7,265,000
Switzerland....	17,965,000	.....	17,965,000

The New York banks do not separate gold and silver. The foreign statements are from the *Commercial and Financial Chronicle* of New York.

Silver Market

SILVER AND STERLING EXCHANGE.

June.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.	June-July.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.
25	4.8695	54¾	25¼	29	4.8695	54	24⅞
26	4.8695	54¼	25	30	4.8690	53¾	24¾
27	4.8700	53¾	24¾	1	4.8695	53½	24⅛

*New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 0.925 fine.

Messrs. Pixley & Abell report silver shipments from London to the East for the year to June 18:

	1907.	1908.	Changes.
India... ...	£5,867,244	£3,825,658	D. £2,041,586
China.	.....	516,400	I. 516,400
Straits.....	505,362	90,510	D. 414,852
Total.....	£6,372,606	£4,432,568	D. £1,940,038

Receipts for the week were £5000 from the West Indies and £182,000 from New York; total, £187,000. Exports were £127,500 to India.

The silver market has reacted rather sharply the past week, on cessation of the active demand for the Indian bazaars; closing at 24 11/16d. in London.

Indian Exchange has revived a little, and for the first time in several weeks there were 10 lakhs of Council bills offered in London this week. The bills were all taken at 15.91d. per rupee.

Copper, Tin, Lead and Zinc

DAILY PRICES OF METALS.

June-July.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. Cts. per lb.	Spelter. New York, Cts. per lb.	Spelter. St. Louis, Cts. per lb.
25	12¾ @13	12½ @12¾	57⅛	27½	4.47½ @4.50	4.45 @4.50	4.30 @4 35
26	12¾ @13	12⅝ @12¾	56⅞	27⅜	4.45 @4.50	4.45 @4.50	4 30 @4 35
27	12¾ @12⅞	12⅝ @12⅝	.....	27⅜	4.42½ @4.47½	4.45 @4.50	4.30 @4.35
29	12⅝ @12¾	12¾ @12⅝	56¼	27⅜	4.42½ @4.45	4.45 @4.50	4 30 @4 35
30	12⅝ @12¾	12⅜ @12⅝	56¾	27⅜	4.42½ @4 45	4.45 @4.50	4.30 @4.35
1	12⅝ @12¾	12⅜ @12⅝	56⅛	27¼	4.42½ @4.45	4.45 @4.50	4.30 @4.35

London quotations are per long ton (2240 lb.) standard copper, which is now the equivalent of the former g.m.b's. The New York quotations for electroytic copper are for cakes, ingots or wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

Copper—The stagnation reported last week was short-lived. The discouraging advices received from Europe induced holders to reduce their prices, whereupon a heavy demand for home trade developed, resulting in relatively larger transactions than for some time past. Domestic consumers appear now to be in the frame of mind which was experienced in the case of European buyers late last year, in so far as they are willing to anticipate their requirements, feeling that prices cannot possibly recede very much from the present level. It is, therefore, expected that on every slight concession heavy purchases will be made. The market closes uncertain at 12⅝@12¾c. for Lake copper; 12⅜@12⅝c. for electrolytic in ingots, cakes and wirebars. The average of the week for casting copper is 12¼@12⅜ cents.

The standard market in London has shown a declining tendency throughout the week. The lower prices have not encouraged new speculation and the close is weak at £56 5s. for spot, £57 for three months.

Statistics for the second half of June show an increase in the visible supplies of 4000 tons.

Refined and manufactured sorts we quote: English tough, £59 10s.@£60 10s.; best selected, £59 10s.@£60 10s.; strong sheets, £71 10s.@£72 10s.

Exports of copper from New York and Philadelphia for the week were 3330 long tons. Our special correspondent gives the exports from Baltimore at 2980 long tons.

Manufactured Copper—Sheets, cold-rolled, 18c.; hot-rolled, 17c. Wire, 14¾c. base.

Tin—The London market has again been suffering from almost an entire absence of interest on the part of American buyers. While during the latter half of last week it showed quite a steady tone, it has become weak at this writing. The close is cabled at £124 7s. 6d. for spot, £125 7s. 6d. for three months.

The domestic market anticipated somewhat the decline in London, and transactions among dealers took place at somewhat below the import figures. Consumers continue to be indifferent toward this metal, and the quotation for spot at the close is about 27¼ cents.

Statistics for the month of June show a decrease in the visible supplies of 1500 tons.

Lead—Speculators who bought heavily at the lower prices which ruled some time ago, and who have now to take delivery of the quantities sold them, have been anxious to unload. Buyers are quick to realize this, and business could only be induced at concessions in prices. The close is lower at 4.42½@4.45c. New York.

Forced sales in the London market have established a lower level, and the close is cabled at £12 6s. 3d. for Spanish lead, £12 8s. 9d. for English lead.

Spelter—Business continues of a retail character, and the market has eased off further to 4.30@4.35c. St. Louis. 4.45@4.50c. New York.

Reports from Europe are very discouraging and prices again close lower at £18 5s. for good ordinaries, £19 for specials.

Zinc Sheets—Base price is 7c., f.o.b. La Salle-Peru, Ill., less 8 per cent.

Other Metals

Antimony—There have been a few small sales by dealers who are tired of holding out for higher prices. The manufacturers are indifferent and are not buying. Prices are 8⅝@8¾c. for Cookson's, 8¼@8½c. for Hallett's and 8@8¼c. for ordinary brands.

Aluminum—Ingots, American No. 1, in large quantities, 33c. per lb. Rods and wire, 38c. base; sheets, 40c. base. Foreign metal is offered at rather lower prices.

Cadmium—In 100-lb. lots, $1.25 per lb., at Cleveland, Ohio.

Nickel—According to size of lot and terms of sale, 45@50c., New York.

Quicksilver—New York price is $44 per flask for large lots; $45 for jobbing orders. San Francisco, large lots nominal at $43.50, domestic, and $42, export; small orders, $45@46. London is £8 per flask, with £7 17s. 6d. quoted by second hands.

Platinum—The market is without life and prices remain unchanged at $23.50 per oz. for hard platinum, $21 for ordinary and $16 for scrap.

Missouri Ore Market

Joplin, Mo. June 27—The highest price paid for zinc ore was $37.75 per ton, the base price ranging from $33 to $35.50 per ton of 60 per cent. zinc. Average price all grades $32.04.

The highest price paid for lead ore was $66 per ton f.o.b. Galena, medium grades selling at $62 to $64 per ton, and all grades averaging $62.08.

As will be seen by the assay base quotation there was an advance of $2 per ton on the medium and lower grade ores, and this was quite general, though the increased sales of silicate prevented the average price being proportionately advanced.

Following are the shipments from the district for the week ending June 27, and the total for the first half of 1908:

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	3,725,650	1,026,570	$92,460
Joplin	1,503,350	236,950	32,763
Galena	608,640	582,660	28,383
Alba-Neck	725,300	.....	12,693
Badger	716,640	15,240	12,671
Duenweg	439,670	47,170	8,544
Aurora	559,750	.....	8,388
Granby	240,000	100,000	6,600
Carthage	375,430	.....	6,570
Prosperity	390,210	2,450	6,321
Miami	296,630	.....	4,543
Spurgeon	172,600	72,880	4,059
Quapaw-Baxter	125,890	62,730	3,895
Zincite	121,970	9,530	2,307
Sarcoxie	72,010	.....	1,152
Oronogo	52,030	1,130	774
Carl Junction	44,880	.....	763
Wentworth	54,940	.....	727
Totals	10,275,190	2,157,310	$233,613
Six months	240,270,680	37,267,240	$5,084,582
Zinc value, the week, $164,631; 6 months,			$4,089,441
Lead value, the week, 68,982; 6 months,			995,141

Average ore prices in the Joplin market were, by months:

ZINC ORE AT JOPLIN.			LEAD ORE AT JOPLIN.		
Month.	1907.	1908.	Month.	1907.	1908.
January	45.84	35.56	January	83.58	46.88
February	47.11	34.92	February	84.58	49.72
March	48.66	34.19	March	82.75	49.90
April	48.24	34.08	April	79.76	52.47
May	45.98	33.39	May	79.56	56.05
June	44.82	32.07	June	73.66	60.48
July	45.79	.....	July	58.18	.....
August	43.22	.....	August	59.54	.....
September	40.11	.....	September	53.52	.....
October	39.83	.....	October	51.40	.....
November	35.19	.....	November	43.40	.....
December	30.87	.....	December	37.71	.....
Year	43.68	.....	Year	68.90	.....

Wisconsin Ore Market

Platteville, Wis., June 27—The highest price paid for zinc ore this week was $35, the base price advancing to $34 per ton of 60 per cent. zinc. Lead ore sold as high as $62 per ton.

Shipments for week ended June 27:

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Hazel Green	502,000	.....	.....
Platteville	294,700	.....	167,600
Benton	238,580	79,600	.....
Highland	195,700	43,080	.....
Livingston	130,000	.....	.....
Days Siding	88,000	88,000	.....
Linden	74,070	.....	.....
Cuba City	69,500	178,370	.....
Harker	56,810	.....	.....
Dodgeville	42,000	8?,000	.....
Elmo	.....	62,300	.....
Total	1,691,360	531,350	167,600
Year to June 27	42,905,445	5,045,725	481,930

Hazel Green, not reported last week, shipped then 724,000 lb. zinc ore. In addition to the above there was shipped this week to the electrostatic separator at Platteville, from Benton, 230,200 lb.; from Dodgeville, 59,900 lb.; from Cuba City, 60,300 lb.; from Rewey, 60,400 lb.; from Linden, 49,200 lb. Shipped to the Enterprise roaster at Platteville, from Strawbridge, 188,200 lb.; and to the Joplin Separator Works at Galena, from Benton, 70,700 lb. zinc ore.

Chemicals

New York, July 1.—The general market is quiet, but this is to be expected at this season. It is believed in the trade that in August a firm market will prevail and hand-to-mouth buying will be superseded by substantial contracts. Dealers in clays and earths report fair business, and producers of pyrites have closed some large contracts.

Copper Sulphate—Demand is fair and some small shipments have been made. Standard goods remain at $4.65 per 100 lb. for carloads and $4.90 for smaller lots.

Nitrate of Soda—The market is quiet and business has been light, and for immediate delivery. Prices remain at 2.30c. for spot and 2.32½ for other positions of 1908.

Phosphate Rock—J. M. Lang & Co. report shipments of phosphate rock through the port of Savannah, Ga., at 9917 tons in May, 1908. Of these 7825 tons went to Germany and 2092 tons to England.

Mining Stocks

New York, July 1—The general stock markets have been quiet, not to say dull, with small fluctuations and rather a lower range of prices. Summer quiet seems to set in.

On the curb also, matters have been dull. A little activity in the copper shares soon ended, leaving them quiet. There was little change in prices though dealings were moderate.

A sale of Homestake, of South Dakota, was made June 27 on the Stock Exchange; 100 shares changing hands at $76 per share. On June 30 another sale was made at $76.50 per share.

The Anaconda Copper Company today declared the usual dividend of 50c. per share.

Boston

June 30—A sharp advance in a few of the high-grade copper stocks has been the feature in this market. Otherwise price changes are unimportant. Osceola has had the most marked advance, being up $11 for the week to $103. Of this advance, $5 occurred today. The dividend period is near and expectations are that there will be a resumption of dividends, of which there have been none for a year. Tamarack, another Bigelow stock, has also given an account of itself, being up $6.75 to $62.75, but with no dividend mentioned. Quincy also did well, advancing $2.50 to $87 on limited dealings. Calumet & Hecla is off $5 to $655 on very limited dealings. Copper Range and North Butte have, as usual, been the leaders in activity. The former is $1.50 higher for the week at $72.50. President Paine, who has just returned from the Copper Range, speaks rather discouragingly of the Globe tract on which $400,000 has been spent to date in putting down the shaft.

A little activity developed in some of the prospects, but it was short-lived. Elm River touched $1.62½, Mass $4.87½ and Wyandot $1.87½. Accompanying these advances were reports of expectations of striking the Lake lode.

On the curb Ahmeek, a Bigelow stock, rose $4 to $78.

Several payments due on the Davis-Daly property July 1 will be taken care of by the vendors. No plan has yet been formulated for a reorganization.

STOCK QUOTATIONS

NEW YORK June 30		BOSTON June 30	
Name of Comp.	Clg.	Name of Comp.	Clg.
Alaska Mine	¼	Adventure	3⅞
Amalgamated	65⅞	Allouez	28½
Anaconda	41⅞	Am. Zinc	‡27¼
Balaklala	⅜	Arcadian	‡3¼
British Col. Cop.	4¾	Arizona Com	18
Butte & London	....	Atlantic	15
Butte Coalition	22¼	Bingham	‡.25
Colonial Silver	½	Boston Con	11¼
Cum. Ely Mining	7⅝	Calumet & Ariz	108½
Davis Daly	1¾	Calumet & Hecla	655
Dominion Cop	1⅛	Centennial	‡23½
Douglas Copper	3¾	Con. Mercur	‡.40
El Rayo	2	Copper Range*	72½
Florence	3⅛	Daly-West	10⅝
Foster Cobalt	41	Franklin	9
Furnace Creek	.14	Greene-Can	10⅛
Giroux	3½	Isle Royal	19¾
Gold Hill	⅛	La Salle	‡13½
Goldfield Con	5⅜	Mass	‡4¾
Granby	‡96¼	Michigan	‡9½
Greene Gold	¾	Mohawk	58
Greene G. & S	¼	Nevada	11⅝
Greenw'r & D.Val.	.75	North Butte	66¼
Guanajuato	1¾	Old Colony	.25
Gnggen. Exp.	150	Old Dominion	33½
Hanapah	‡.20	Osceola	101
McKinley Dar*	76	Parrot	22¾
Micmac	2⅞	Quincy	87
Mines Co. of Am.	1⅛	Rhode Island	3¼
Mitchell Mining	¾	Santa Fe	‡1⅞
Mont. Sho.C	.74	Shannon	13½
Nev. Utah M. & S	2 13/16	Superior	16¼
Newhouse M. & S	5	Tamarack	62½
Nipissing Mines	7¼	Trinity	12½
Old Hundred	½	United Cop., com.	17
Silver Queen	1.03	U. S. Oil	‡24⅜
Stewart	1⅛	U. S. Smg. & Ref.	‡34¼
Tennessee Cop'r.	‡36⅜	U.S.Sm. & Re., pd.	42¼
Tri-Bullion	1⅜	Utah Con*	41
Union Copper	¾	Victoria	4½
Utah Apex	4⅛	Winona	5½
Utah Copper	33¼	Wolverine	132
Yukon Gold	3½	Wyandotte	‡1⅝

*Ex. Div. †Ex. Rights. ‡Last quotation.

N. Y. INDUSTRIAL	
Am. Agri. Chem.	‡23½
Am. Smelt. & Ref.	75¾
Am. Sm. & Ref., pf.	99¼
Bethlehem Steel	‡13½
Colo. Fuel & Iron	27
Federal M. & S., pf.	‡74½
Inter. Salt	18½
National Lead	65
National Lead, pf.	99½
Pittsburg Coal	‡12
Republic I. & S.	18
Republic I. & S., pf.	66⅛
Sloss-Sheffield	52
Standard Oil	600½
U. S. Red. & Ref.	‡10
U. S. Steel	37⅞
U. S. Steel, pf	102⅜
Va. Car. Chem	22¾

BOSTON CURB	
Ahmeek	72
Black Mt.	‡4⅛
East Butte	‡6⅜
Hancock Con.	‡4¾
Keweenaw	6
Majestic	.56
Raven	.85
Shawmut	.32
Superior & Pitts.	11⅞
Troy Man	‡.40

ST. LOUIS June 27		
N. of Com.	High.	Low.
Adams	.30	.20
Am. Nettie.	.03	.02
Center Cr'k	2.00	1.50
Cent. C. & C.	70.00	68.00
C.C. & C. pd.	79.00	77.00
Cent. Oil	110.00	100.00
Columbia	4.00	3.00
Con. Coal	18.00	16.00
Doe Run	125.00	110.00
Gra. Bimet.	.20	.16
St. Joe.	15.00	13.00

LONDON July 1		
Name of Com.	Clg.	
Dolores	£1	11s 3d
Stratton'sInd.	0	1 6
Camp Bird	0	13 0
Esperanza	1	9 0
Tomboy	1	11 3
El Oro	1	6 9
Oroville	0	10 7½

Cabled through Wm. P. Bonbright & Co., N. Y.

NEVADA STOCKS. July 1.
Furnished by Weir Bros. & Co., New York.

Name of Comp.	Clg.	Name of Comp.	Clg.
COMSTOCK STOCKS		Silver Pick	.13
Belcher	‡.20	St. Ives	.24
Best & Belcher	‡.40	Triangle	.03
Caledonia	‡.06	BULLFROG STOCKS	
Challar	‡.05	Bullfrog Mining	.03
Comstock	.30	Bullfrog Nat. B.	.04
Con. Cal. & Va.	‡.49	Gibraltar	.04
Crown Point	‡.24	Gold Bar	.03
Exchequer	‡.12	Homestake King	.31
Gould & Curry	‡.11	Montgomery Mt.	.06
Hale & Norcross	‡.16	Mont. Shoshone C.	.68½
Mexican	‡.35	Original Bullfrog	.01
Ophir	‡2.40	Tramp Cons	.14
Overman	‡.06	MANHAT'N STOCKS	
Potosi	‡.10	Manhattan Cons.	.08
Savage	‡.23	Manhat'n Dexter	.05
Sierra Nevada	‡.17	Jumping Jack	.04
Union	‡.27	Stray Dog	.03
Utah	...	MISCELLANEOUS	
Yellow Jacket	‡.49	Golden Boulder	.07
TONOPAH STOCKS		Bonnie Clare	.05
Belmont	.84	Lee Gold Grotto	...
Extension	.66	Nevada Hills	1.50
Golden Anchor	.01½	Nevada Smelting	.75
Jim Butler	.22	Pittsburgh S. Pk.	1.08
MacNamara	.33	Round Mt. Sphinx	.26
Midway	.36		
Montana	1.42		
North Star	.06		
Tono'h Mine of N.	7.50		
West End Con	.54		
GOLDFI'D STOCKS			
Adams	.03		
Atlanta	.16		
Booth	.15		
Columbia Mt.	.13		
Comb. Frac	.54		
Cracker Jack	.04		
Dia'dfield B. B. C.	.16		
Goldfield Belmont	.14		
Goldfield Daisy	.80		
Great Bend	.25		
Jumbo Extension	.30		
Katherine	...		
Kendall	.13		
Lone Star	.06		
May Queen	.05		
Oro	.08		
Red Hill	.17		
Roanoke	...		
Sandstorm	.23		

COLO. SPRINGS June 27	
Name of Comp.	Clg.
Acacia	5¼
Black Bell	....
C. C. Con	3
Dante	‡7
Doctor Jack Pot	6⅛
Elkton	56¼
El Paso	35
Findlay	24
Gold Dollar	6
Gold Sovereign	3
Isabella	31¼
Index	...
Jennie Sample	3
Jerry Johnson	4½
Mary McKinney	28
Pharmacist	‡3¼
Portland	1.06
Un. Gold Mines	4
Vindicator	‡85
Work	8¾

Assessments

Company.	Delinq.	Sale.	Amt.
Birchville, Cal.	June 20	July 11	$0.02
Bullion, Nev.	June 25	July 17	0.05
Butler-Liberal, Utah.	July 17	Aug. 6	0.02
Chollar, Nev.	July 8	July 30	0.10
Con. Imperial, Nev.	June 17	July 9	0.01
Con. Virginia, Nev.	June 12	July 3	0.25
Confidence, Nev.	June 10	June 30	0.20
Lead King, Utah.	July 1	July 28	0.01
Little Chief, Utah.	June 17	July 7	0.01
Lucky Dutchman, Nev.	June 30	July 20	0.01
Mountain Dell, Utah.	June 24	July 13	0.02
N. Y. Bonanza, Utah.	June 9	June 30	0.02
Oro Cobre, Cal.	July 16	Aug. 3	0.02
Overman, Nev.	June 19	July 10	0.05
Peruvian Con., Utah.	June 22	July 7	0.01
Silver King Con., Utah.	June 11	June 30	0.10
Spanish Ridge, Cal.	June 1	July 1	0.05
Tomahawk, Nev.	Julp 10	Aug. 12	0.01
Tonopah North Star, Nev.	June 24	...	0.01
Union Con., Nev.	June 15	July 9	0.10

Monthly Average Prices of Metals

SILVER

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	68.673	55.678	31.769	25.738
February	68.835	56.000	31.852	25.856
March	67.519	55.365	31.325	25.570
April	65.462	54.506	30.253	25.133
May	65.981	52.795	30.471	24.377
June	67.090	53.663	30.893	24.760
July	68.144	.....	31.366	.....
August	68.745	.....	31.637	.....
September	67.792	.....	31.313	.....
October	62.435	.....	28.863	.....
November	58.677	.....	27.154	.....
December	54.565	.....	25.362	.....
Year	65.327	.....	30.188	.....

New York, cents per fine ounce; London, pence per standard ounce.

COPPER

	NEW YORK.				LONDON.	
	Electrolytic		Lake.			
	1907.	1908.	1907.	1908.	1907.	1908.
January	24.404	13.726	24.825	13.901	106.739	62.386
February	24.869	12.905	25.236	13.098	107.356	58.786
March	25.065	12.704	25.560	12.875	106.594	58.761
April	24.224	12.743	25.260	12.928	98.625	58.331
May	24.048	12.598	25.072	12.788	102.375	57.387
June	22.665	12.675	24.140	12.877	97.272	57.842
July	21.130	.....	21.923	.....	95.016	.....
August	18.356	.....	19.255	.....	79.679	.....
September	15.565	.....	16.047	.....	68.375	.....
October	13.169	.....	13.551	.....	60.717	.....
November	13.391	.....	13.870	.....	61.226	.....
December	13.163	.....	13.393	.....	60.113	.....
Year	20.004	.....	20.661	.....	87.007	.....

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

TIN AT NEW YORK

Month.	1907.	1908.	Month.	1907.	1908.
January	41.548	27.380	July	41.091	.....
February	42.102	28.978	August	37.667	.....
March	41.313	30.577	September	36.689	.....
April	40.938	31.702	October	32.620	.....
May	43.149	30.015	November	30.833	.....
June	42.120	28.024	December	27.925	.....
			Av. year	38.166	.....

Prices are in cents per pound.

LEAD

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	6.000	3.691	19.828	14.469
February	6.000	3.725	19.531	14.250
March	6.000	3.838	19.703	13.975
April	6.000	3.993	19.975	13.469
May	6.000	4.253	19.688	12.938
June	5.760	4.466	20.188	12.600
July	5.288	.....	20.350	.....
August	5.250	.....	19.063	.....
September	4.813	.....	19.775	.....
October	4.750	.....	18.531	.....
November	4.376	.....	17.281	.....
December	3.658	.....	14.500	.....
Year	5.325	.....	19.034	.....

New York, cents per pound. London, pounds sterling per long ton.

SPELTER

MONTH.	New York.		St. Louis.		London.	
	1907.	1908.	1907.	1908.	1907.	1908.
January	6.732	4.513	6.582	4.363	27.125	20.563
February	6.814	4.788	6.664	4.638	25.938	20.875
March	6.837	4.665	6.687	4.527	26.094	21.075
April	6.685	4.645	6.535	4.495	25.900	21.344
May	6.441	4.608	6.291	4.453	25.563	19.906
June	6.419	4.543	6.269	4.393	25.469	19.000
July	6.072	.....	5.922	.....	23.850	.....
August	5.701	.....	5.551	.....	21.969	.....
September	5.236	.....	5.086	.....	21.050	.....
October	5.430	.....	5.280	.....	21.781	.....
November	4.925	.....	4.775	.....	21.438	.....
December	4.254	.....	4.104	.....	20.075	.....
Year	5.962	.....	5.812	.....	23.771	.....

New York and St. Louis, cents per pound. London in pounds sterling per long ton.

CHEMICALS, MINERALS, RARE EARTHS, ETC.—CURRENT WHOLESALE PRICES.

ABRASIVES—		
Bort, good drill quality, carat		$85.00
Carborundum, f.o.b. Niagara Falls, powd	lb.	.08
Grains	"	.10@.17
Corundum	"	.07@.10
Crushed Steel, f.o.b. Pittsburg	"	.05¼@.06
Emery, in kegs: Turkish flour	"	.01½@.02½
Grains	"	.03½@.04½
Naxos flour	"	.01½@.02½
Grains	"	.03½@.04½
Chester flour	"	.01½
Grains	"	.03½@.04½
Peekskill, f.o.b. Easton, Pa., flour	"	.01½@.01½
Grains, in kegs	"	.02½@.02½
Garnet, per quality	ton	25.00@35.00
PumiceStone, Am. Powd.	100 lb.	1.60@2.00
Italian, powdered	"	.01¼@.01½
Lump, per quality	"	.03@.20
Rottenstone, ground	"	.02½@.04½
Lump, per quality	"	.05@.25
Rouge, per quality	"	.05@.30
Steel Emery, f.o.b. Pittsburg	"	.07½@.07¾
ACIDS—		
Acetic 28%	lb.	.026@.03
Boric	"	.08@.08¼
Hydrofluoric, 30%	"	.02¾@.03
" 48%	"	.06
" 60%	"	.10
Hydrochloric acid, 20°, per lb		1.25@1.50
Nitric acid, 38°	per lb.	4.25@4.62½c.
Sulphuric acid, 50°, bulk, per ton		$12 up.
60°, 100 lb. in carboys		.85@1.12½
60°, bulk, ton		16.00@18.00
66°, 100 lb. in carboys		1.00@1.25
66°, bulk, ton		18.00
Oxalic	"	.07@.07¼
ALCOHOL—Grain 95%	gal.	2.63
Denatured		.39@.45
Refined wood, 95@97%	"	.41@.47
ALUM—Lump	100 lb.	$1.75
Ground	"	1.85
Chrome Alum	lb.	.05½@.06
ALUMINUM—Sulphate, com'l	"	1.10@1.75
AMMONIA—24 deg. lb		.04¼@.05¼
" 26 " "		.04¾@.05¾
AMMONIUM—		
Bromide	lb.	.23
Carbonate	"	.07½@.08
Muriate grain	"	.05¾@.06½
Lump	"	.09¼@.09½
Sulphate, 100 lb		3.05@3.10
Sulphocyanide com	"	.30
" " chem. pure	"	.40
ANTIMONY—needle, lump lb		.03¼@.04
ARSENIC—White	"	.03¼@.03¾
Red	"	.07½@.07¾
ASPHALTUM—		
Barbadoes	per ton	40.00@80.00
West Indies	"	20.00@60.00
Egyptian	lb.	.12@.14
Gilsonite, Utah ordinary	per ton.	35.00
Trinidad	"	28.00@30.00
California	"	21.00@27.00
BARIUM—		
Carb. Lump, 80@90%	lg. ton.	30.00@35.00
Precipitated 96@98%	"	31.50@35.00
Powdered 80@90%	lb.	.02½@.02¾
Chloride com'l	ton.	38.00@40.00
Nitrate, powdered, in casks	lb	.05½@.06
Blanc Fixe	per lb.	.02¾
BARYTES—		
Am. Ground	sh. ton.	14.00@21.00
Floated	"	22.00
Foreign floated	"	19.50@22.50
BISMUTH—Sub-nitrate	lb.	1.50
BLEACHING POWDER—35%, 100 lb		1.25@1.40
BLUE VITRIOL—(copper sulphate), carload, per 100 lb		4.65
BONE ASH	lb.	.02½@.04
BORAX	"	.04½@.05½
CALCIUM—Acetate, gray, 100 lb.		2.00@2.05
Acetate, brown	"	1.25@1.30
Carbide, ton lots f.o.b. Niagara Falls, N. Y., for Jersey City, N. J.	sh. ton.	65.00
Chloride, f.o.b. N. Y.	"	11.00@14.00
CEMENT—		
Portland, Am. 500 lb.	bbl.	1.55@1.60
Foreign	"	2.25@2.90
"Rosendale," 300 lb.	"	.85
(in sacks)		.65
Slag cement	"	.75@1.25
CHROME ORE—		
New Caledonia 50% ex. ship N. Y.	per lg. ton	17.50@20.00
Bricks, f.o.b. Pittsburg, M.	"	175.00
CLAY, CHINA—Am. common ex-dock, N. Y.	"	8.50@9.00
Foreign	"	10.00@17.50
COBALT—Oxide	lb.	1.45
COPPERAS—Bulk	100 lb.	$0.55
In bbls	"	.65@.75
In bags	"	.60@.70
CRYOLITE	lb.	.06¼@.06¾
FELDSPAR—Ground best sh. ton.		10.50@15.00
FIRE BRICK—		
American	per M.	30.00@40.00
Imported	"	30.00@45.00
St. Louis No. 1	"	18.00
" No. 2	"	15.00
Extra	"	20.00@23.00
FIRE CLAY—F. o. b. St. Louis.		
St. Louis, extra quality	per ton	5.00
" ordinary	"	2.50
FLUORSPAR—		
Domestic f.o.b. shipping port:		
Lump	lg. ton.	8.00@10.00
Ground	"	11.50@13.50
Foreign crude ex dock		8.00@10.00
FULLER'S EARTH—Lump, 100 lb.		.75@.85
Powdered	"	.75@.85
GRAPHITE—Ceylon		
Flying dust, finest to best	lb.	.01@.04
Dust	"	.01¾@.05
Chip	"	.02¾@.07½
Lump	"	.04@ 10
Large lump	"	.07@.10
GYPSUM—		
Fertilizer	sh. ton.	5.00
Ground	sh. ton.	4.00@7.00
INFUSORIAL EARTH—		
Ground Am. best	lb.	.01¾
French	lg. ton.	55.00
German	lb.	.02½@.02¾
LEAD—Acetate (sugar of) brown	lb.	.07¾
Nitrate, com'l	"	.08¼@.08¾
MAGNESITE—Greece.		
Crude (95%)	lg. ton.	8.00@10.00
Calcined, powdered	sh. ton.	30.00@40.00
Bricks, domes, per qual. f.o.b. Pittsburg	M.	160@200
MAGNESIUM—		
Chloride, com'l	100 lb.	.80@1.00
Sulphate (Epsom salt)	100 lb.	.85@1.00
MANGANESE—		
Foreign, crude, powdered:		
70@75% binoxide	lb.	.01@.01¼
75@85% binoxide	"	.01¼@.01½
85@90% binoxide	"	.01½@.05
90@95% binoxide	"	.06½
Ore, 80%-85%	sh. ton.	18.00@40.00
MARBLE—Flour	sh. ton.	8.50@10.00
MINERAL WOOL—		
Slag, ordinary	"	19.00
Selected	"	25.00
Rock, ordinary	"	32.00
Selected	"	40.00
MONAZITE SAND—		
Guar. 97%, with 5% Thorium oxide, nominal	lb.	.08 and up.
NICKEL—		
Oxide, crude, lb. (77%) for fine metal contained		.47
Sulphate, single	lb.	.09@.11
" double	"	.06½@.08
NITRATE OF SODA—100 lb. 95% for '08		2.30
95% for 1909		2.30
95% for 1910		2.32½
96% is 5c higher per 100 lb.		
OZOKERITE—best	lb.	.14@.17
PAINTS AND COLORS—		
Litharge, Am. powdered	"	.06½@.06¾
English glassmakers'	"	.06¾@.08½
Lithopone	"	.03½@.07
Metallic, brown	sh. ton.	16.50@22.00
Red	"	14.00@18.00
Ocher, Am. common	"	8.50@9.00
Best	"	16.00
Dutch, washed	lb.	.02½@.03
French, washed	"	.01½@.02½
Paris green, pure, bulk	"	.26
Red lead, American	"	.06½@.06¾
Foreign	"	.08½@.08½
Turpentine, spirits bbl., per gal.		.43
White lead, Am., dry	lb.	.05½@.06
American, in oil	"	.06½@.06¾
Foreign, in oil	"	.10½@.10¾
Zinc white, Am. extra dry	"	.05½@.05¾
French, red seal, dry	"	.08½@.08¾
" Green seal, dry	"	.10½@.10¾
PHOSPHATES—Acid	60c per unit	
*Fla., hard rock		9.50@10.00
land pebble 68%		4.00@4.25
†Tenn., 78@80%		6.00@6.50
75%		4.50@5.00
68@72%		4.00@4.25
‡So. Car. land rock		6.75@7.00
" river rock		7.00@7.25
POTASSIUM—		
Bicarbonate crystal	lb.	$.08½@.09
Powdered or granulated	"	.09@.09½
Bichromate, Am	"	.08½@.09
Scotch	"	.10¾
Bromide	"	.15@.17
Carbonate (80@85%)	"	.03½@.04
Caustic, ordinary	"	.04½@.05¾
Elect. (90%)	"	.05½@.06
Chloride (muriate), 100 lb.		1.90
Chlorate, powdered	"	.09½@.09¾
Crystals	"	09@09½
Cyanide (98@99%)		
Carloads (30,000 lb.)	"	18c.
5-ton lots	"	18½c.
Less than 5 tons	"	19c.
Kainite, long ton, bulk, 8.50; bags, 9.50.		
Permanganate	lb.	.09½@.10
Prussiate, yellow	"	.14@.14½
Red	"	.32@ 36
Sulphate	100 lb.	2.18½@2.21½
PYRITE—		
Domestic, non-arsenical, furnace size, f.o.b. mines	per unit	11@11½c.
Domestic, non-arsenical, fines, per unit, f.o.b. mines		10@10½c.
Imported non-arsenical, furnace size, per unit		.12½@.13
Imported, arsenical, furnace size, per unit		.12@.12½
Imported fines, arsenical, per unit		.08½@.09
" " non-arsenical, per unit		10½@11c

Pyrite prices are per unit of sulphur. An allowance of 25c. per ton is made when delivered in lump form.

SALT—N. Y. com. fine 280 lb.	bbl.	.72@1.18
N. Y. agricultural	sh. ton.	3.80@4.50
SALTPETER—Crude	100 lb.	4.50@5.00
Refined, crystals	"	5.50@6.00
SILICA—		
Ground quartz, ord'ry	lg. ton	10.00@15.00
Silex	"	13.00@40.00
Lump Quartz	"	5.00@6.00
Glass sand	"	2.75
SILVER—Nitrate, crystals	oz.	.36@.39
SODIUM—		
Acetate	lb.	.04¼@ 04¾
"Alkali," per 100 lb., 58/48		.80@ 87½
Bicarb. soda, per 100 lb		1.10@1.40c.
Soda, caustic, per 100 lb., 76/60		1.75@1.85
" " powdered		.02¾@.03½
Salt cake, per 100 lb, bulk		.40
" " bbl		.65@.85
Soda, monohydrate, per lb		1.4@1.75c.
Bichromate	lb.	.07½@.07¾
Bromide	"	.15@.17
Chlorate, com'l	"	.09@.09¼
Cyanide ("100% KCN")		
Carloads (30,000 lb.)	"	18c.
5-ton lots	"	18½c.
Less than 5 tons	"	19c.
Hyposulphite, Am	"	1.35 up
German	"	1.60@1.70
Phosphate	100 lb.	2.10@2.30
Prussiate	"	.08¾@.09½
Sal soda, f.o.b. N. Y	100 lb.	.65@.70
Foreign, f.o.b. N. Y.	"	.80@1.00
Silicate, com'l	100 lb.	.80@1.15
Sulphate, com'l, (Glauber's salt)	100 lb.	.60@.75
" " calcined		.65@.85
STRONTIUM—Nitrate	lb.	.07¾@ 8½
SULPHUR—		
Louisiana (prime) to New York, Boston or Portland	lg. ton	22.00
To Philadelphia or Baltimore	"	22.00
Roll	100 lb.	1.85@2.15
Flour	" "	2.00@2.40
Flowers, sublimed	" "	2.20@2.60
TERRA ALBA—French & Eng.	100 lb.	.65@1.00
TALC—Domestic	sh. ton.	15.00@25.00
French	"	16.00@26.00
Italian, best	"	35.00@40.00
TIN—Bi-chloride, 50%	lb.	.08¾
Crystals	"	.18½ up
Oxide, lb		.33@.35
URANIUM—Oxide	"	3.50
ZINC—		
Chloride solution, com'l 20°	"	.02½
Chloride, granular	"	.04½@.06
Dust	"	.05@.05½
Sulphate	"	2.15 up

NOTE—These quotations are for ordinary wholesale lots in New York unless otherwise specified, and are generally subject to the usual trade discounts. In the cases of some of the important minerals, such as phosphate rock, pyrites, and sulphur, in which there are well established markets, the quotations fully represent the latter. But in the cases of some of the minor mineral products, the quotations represent what dealers ask of consumers and not what producers can realize in selling their outputs as matters of private contract.

*F. o. b. Florida or Georgia ports. †F. o. b. Mt. Pleasant. ‡On vessel Ashley River, S. C.

THE MINING INDEX.

The editors of this paper read all the important publications of the world that relate to mining and the treatment of minerals. This index is published as a reference for all interested and to make it impossible for readers of the ENGINEERING AND MINING JOURNAL to miss any important article published anywhere.

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ANTIMONY

6576—ANTIMONY SULPHIDE — Purity and Volatility of Precipitated Antimony Sulphide. Lewis A. Youtz. (Journ. Am. Chem. Soc., June, 1908: 17 pp.) Results of experiments taken up to discover whether pure antimony trisulphide could be obtained by precipitation by hydrogen sulphide, the volatility of the product of precipitation coming up incidentally in the course of the work. 80c.

6577 — ELECTROLYTIC DETERMINATION—Zur Elektroanalytischen Bestimmung des Antimons. O. Scheen. (Zeit. f. Elektrochem., May 8, 1908: 5½ pp.) Discusses previous methods, and their theoretical aspects; describes a new method and the special apparatus required, and tabulates comparative results. 40c.

BAUXITE

6578—COMPOSITION — The Nature of Bauxite. (Eng. and Min. Journ., May 30, 1908: ¾ p.) A short review of the history of the discovery of bauxite and an outline of the various opinions as to its nature and composition. 20c.

BISMUTH

6579 — ELECTROLYTIC DETERMINATION of Bismuth. F. J. Metzger and H. T. Beans. (Journ. Am. Chem. Soc., April, 1908; 3⅓ pp.) The addition of boric acid to the bath has a decided effect on the character of the deposit, and in addition, it serves to bring about the complete solution of bismuth hydroxide without the addition of very large quantities of acetic acid. 80c.

CEMENT

6580—COMPOSITION OF CEMENT—Ein Studienplan für die weitere Erforschung der hydraulischen Bindemittel. K. Zulkowski. (Stahl u. Eisen, May 13, 1908: 3 pp.) A discussion of the chemical composition of Portland cement. To be concluded. 40c.

6581—CONVEYING MACHINERY in the Portland Cement Plant. C. J. Tomlinson. (Proc. A. S. M. E., June, 1908: 4 pp.) A study of this machinery with a view to deciding on a more economical or intelligent use of the same, especially under present conditions, where capacities are increased and the duties heavier and more exacting.

COAL AND COKE

6582—ANALYSIS—Determination of the Value of Coal for Steaming Purposes. Richard K. Meade. (Min. Sci., May 21 and 28, 1908: 2½ pp.) A continuation of the description of the method employed in the analysis of coal in determining its heating qualities, with formulas and terms of expression. 40c.

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6589—BRIQUETTING—Binders for Coal Briquets. James E. Mills. (U. S. Geol. Surv. Bull. 343, 1908; 51 pp.) A complete and comprehensive discussion of all phases of this important subject, based upon investigations made at the fuel-testing plant, St. Louis, Mo.

6590—BRIQUETTING — The Coal-Briquet Plant at Bankhead, Alberta, Canada. Edward W. Parker. (Bi-Monthly Bull. A.I.M.E., May, 1908; 7⅛ pp.) Describes the two units of the plant, and goes into the details of the operations; illustrated.

6591—BRITISH COALFIELD—The Kent Coalfield. (Min. Journ., May 23, 1908; 1 p.) Discusses the geology and early work done in County Kent, England, and describes some of the collieries; illustrated. 40c.

6592—BRITISH COLUMBIA—The Telkwa River and Vicinity, B. C. W. W. Leach. (Geol. Surv. of Can., 1907; 23 pp. 1 map.) A description of the topography, transportation, timber, geology and coal at Telkwa river and vicinity, British Columbia.

6593—COAL MINING—Special Methods for Mining Coal in England. George Rayton Dixon. (Eng. and Min. Journ., June 13, 1908; 3 1/3 pp.) Modifications of standard plans to suit special conditions. Details of an economical system of pony haulage. 20c.

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6598—COAL WASHER — The "Primus" Coal Washer. (Coll. Guardian, June 5, 1908: 1 p.) In this washer the coal moves in the water instead of having the water agitated by means of a plunger. 40c.

6599—DETERIORATION of Coal. S. W. Parr and W. F. Wheeler. (Journ. Am. Chem. Soc., June, 1908; 6½ pp.) Pertains to a deterioration which cannot be ascribed to weathering processes, but rather to the simple fact of the release of the material from the conditions which have surrounded it in the seam. 80c.

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6610—PURCHASE AND USE—Coal from the Standpoint of the Engineer. Geo. H. Ashley. (Sibley Journ. of Eng., May, 1908: 7½ pp.) Deals with the composition and character of coal, its purchase and use. 40c.

6611—QUEENSLAND—The West Moreton (Ipswich) Coalfield. Walter E. Cameron. (Queensland Geol. Surv., Pub. No. 204, 1907; 37 pp.) The West Moreton coal field is at present the chief producing coal field of Queensland. The paper treats of production

and prospects, localities worked for coal, transportation facilities, mapping of the field and general geology.

6612—SHOT FIRING — Group Electric Shot Firing. Sydney F. Walker. (Eng. and Min. Journ., June 20, 1908; 1½ pp.) It is pointed out that the uncertainty in group shot firing is due to the differences in the fuses themselves. 20c.

6613—SUBMARINE COAL MINES. John Johnstone. (Indus. Advocate, May, 1908; 1 p.) No attempt is made to deal with the many different phases which may present themselves, this paper dealing with the subject in a general way. 20c.

6614—WASTE OF MINERAL FUEL RESOURCES. I. C. White. (Eng. and Min. Journ., June 6, 1908; 2 1/3 pp.) Discusses the waste of natural gas and coal, and gives the probable duration of the Appalachian coal supply. 20c.

6615—WEST SCOTLAND — Reports of Mines Inspectors for 1907. (Iron and Coal Tr. Rev., May 22, 1908; ¾ p.) Gives the output of mineral in this district, and interesting and valuable data regarding machinery used, accidents, explosives, safety lamps, etc. 40c.

COPPER

6616—AMALGAMATED COPPER COMPANY. (Eng. and Min. Journ., June 6, 1908; ¾ p.) Abstract of the important parts of the report of this company for 1907. 20c.

6617—BRITISH COLUMBIA—Mining in the Boundary District of British Columbia. Frederick Keffer. (Iron and Coal Tr. Rev., June 5, 1908; 1 1-3 pp.) The mining operations and methods of handling ore in this district, which produces copper from exceedingly low-grade ore, is discussed. Illustrated with cross-sections of workings. Abstract of paper before Brit. Instn. of Min. Engineers. 40c.

6618—CALIFORNIA—Copper Deposits in the Western Foothills of the Sierra Nevada. William Forstner. (Min. and Sci. Press, May 30, 1908; 5½ pp.) A general description of the belt, with short descriptions of some of the deposits which emphasize the geological conditions; illustrated. 20c.

6619—CHEMISTRY IN COPPER AND BRASS INDUSTRIES—The Chemist's Relation to the Copper and Brass Industries, Ernest A. Lewis. (Journ. Soc. Chem. Ind., May 30, 1908; 3¼ pp.) States the position of the chemist in these industries, and discusses and points out the best methods of sampling fuel, copper, spelter, scrap metals, and etc. 80c.

6620—ELECTROLYTIC COPPER-REFINING INDUSTRY in 1907. John B. C. Kershaw. (Electrician, June 5, 1908; 1¼ pp.) The article contains an account of the production and price, the details of various works, new developments and processes. 40c.

6621—ELECTROLYTIC COPPER — The Production of Electrolytic Copper. J. Leeds Brown. (Mines and Mining, May 22, 1908; 1¼ pp.) Outlines the steps involved in the production of commercial copper from crude ore. 20c.

6622—ELECTROLYTIC REFINING—The Tank House and Copper Furnaces of the New Addition to the Raritan Copper Works. Frank D. Easterbrooks. (Electrochem. and Met. Ind., June, 1908; 5¼ pp.) A complete description of the construction and equipment of the tank house and copper furnaces in the new addition at this works; fully illustrated. 40c.

6623—OVERHEATED COPPER — Ueber Verbrennungs-, Ueberhitzungs- und Korrosionserscheinungen am Kupfer und an dessen Fabrikaten. W. Stahl. (Metallurgie, May 22, 1908; 3 pp.) Discusses the composition of overheated copper, its weaknesses, and a number of methods for counteracting them. 40c.

6624—PERU—Los Yacimientos cupriferos de Huitor (Cañete). J. J. Bravo. (Boletin de Minas, Lima, Peru, Apr. 10, 1908; 5 pp.) Describes the geology and the copper ore occurrences in the coastal region of Peru.

6625 — PRECIPITATION OF COPPER FROM MINE WATERS at Butte, Mont. Floyd Bushnell. (Min. Sci., June 4, 1908; 2 pp.) A history of the methods employed in recovering copper from solution in the water from the Butte copper mines and mills; illustrated. 20c.

6626—SMELTING—Modern Reverberatory Smelting of Copper Ore—I. C. Offerhaus. (Eng. and Min. Journ., June 13, 1908; 4 1/3 pp.) Describes the application of the reverberatory furnace for the reduction of ores. The latest furnace at Anaconda is shown in sectional plan and elevation together with many cross-sections illustrating its construction. Dimensions and details of furnace are given and its operation described. To be continued. 20c.

6627—SMELTING—Reverberatory Smelting of Copper Ore—II. C. Offerhaus. (Eng. and Min. Journ., June 20, 1908; 5 pp.) The second instalment of this article on the smelting of copper ores in reverberatory furnaces. It follows the charge from the time it is introduced into the furnace until the matte is tapped, and treats of the starting up of a reverberatory furnace. Illustrated. 20c.

6628—SOUTH AFRICA—Areachap Copper Mines. (So. African Min. Journ., May 16, 1908; 2 pp.) Description of the workings and geological features. This is another African copper mine, which, although very young, is expected to be a large producer eventually. 20c.

6629—SOUTH AFRICA—The Messina Copper Mine. (So. African Min. Journ., May 16, 1908; 1¼ pp.) Completion of the concentrating plant; ancient and modern methods; the scheme of treatment detailed. This is one of several copper mines in Africa for which a great future is predicted. 20c.

6630—TASMANIA — Mining at Mount Lyell. R. C. Sticht. (Am. Min. Rev., June 6, 1908; ¾ p.) Method of mining, reduction work and metallurgical practice at this famous mine in Tasmania. To be continued. 20c.

GOLD AND SILVER

6631—ALABAMA—Notes on Some Gold Deposits of Alabama. H. D. McCaskey. (Geol. Surv., Bull. 340-A, 1908; 17 pp.) Discusses the geology of the district and describes the ore-bodies; gives the production of the different fields and describes some of them in detail.

6632—ALASKA—The Fairbanks and Rampart Quadrangles Yukon-Tanana Region, Alaska. L. M. Prindle. (U. S. Geol. Surv., Bull. 337, 1908; 102 pp.) This report is a second of a series on the Yukon-Tanana region, which extends westward from the international boundary between the Yukon and Tanana rivers to their confluence. The article treats of the descriptive and economic geology, and the various groups of placers in the district. Illustrated.

6633—ARIZONA—The Mineral Deposits of the Cerbat Range, Black Mountains, and Grand Wash Cliffs, Mohave County, Ariz. F. C. Schrader. (Geol. Surv., Bull. 340-A, 1908; 31 pp.) A description of the region, its topography and drainage; discusses the orebodies and geology of the district in detail.

6634—ASSAYING—Experiments in Fire Assaying at the Redjang Lebong Mine, Sumatra. G. V. Hogenraad. (Journ. Chem. Met. and Min. Soc. of South Africa, April, 1908; 2 pp.) This is a discussion by J. E. Clennell of a previous paper upon the use of borax in the assay of gold and silver, in which discussion it is held that the loss of gold and silver is not due to the use of borax. 60c.

6635—BLACK SANDS—Beach Sands of the Pacific Coast. J. L. Mallery. (Northwest Min. Journ., May, 1908; 1½ pp.) This article contains notes on the economic treatment and value of the beach sands as a source of iron and platinum. 20c.

6636—BRITISH COLUMBIA—Nickel Plate Mine and Mill in British Columbia. C. Arthur Alphonson. (Min. Wld., May 30, 1908; 2¼ pp.) A complete history of this mine and the district in which it is situated with a description of both mine and mill; illustrated. 20c.

6637—CALIFORNIA—O'Hara Pocket Mine. (Min. and Sci. Press, June 6, 1908; ¾ p.) The ore occurs in pockets somewhat similar to those of the Bonanza mine near Sonora, Tuolumne County, California. 20c.

6638—REDUCTION OF GOLD CHLORIDE by Charcoal. D. Avery. (Journ. Soc. of Chem. Ind., Mar. 31, 1908; 2½ pp.) Recounts some attempts which were made to prepare charcoal free from all occluded reducing gases, so that the part played by the charcoal alone might be determined. 80c.

6639—COBALT—Notes on Cobalt's Past, Present and Future—I. and II. Alex. Gray. (Min. Wld., June 6 and 13, 1908; 4 pp.) Comments on the injustice done to mining interests by irresponsible criticism, and discusses geology, ore reserves, shipments and the possibilities for the future; illustrated. The second instalment compares the various shipping mines in the district, and mentions briefly the present conditions. 40c.

6640—COLORADO—Gold Placer Deposits near Lay, Routt County, Colo. Hoyt S. Gale. (Geol. Surv., Bull. 340-A, 1908; 12¼ pp.) Description and general geology of the district; takes up the distribution, character and origin of the auriferous deposits.

6641—COLORADO—Primary Gold in a Colorado Granite. John B. Hastings. (Bi-Monthly Bull. A. I. M. E., May, 1908; 6½ pp.) Discusses the gold occurrence in a large area of unconsolidated lake beds, situated about 10 miles from Hartsel, near Antelope Springs, in Park County, Colo.

6642—COLORADO—The Various Mining Districts of Colorado. G. W. Miller. (Min. Sci., May 28, June 4 and 11, 1908; 5 pp.) Second, third and fourth articles of a series descriptive of the different mining camps, their geology, history, ores, methods of mining and ore treatment, dealing in the present instalments with the Cripple Creek district. 60c.

6643—CYANIDATION—Laboratory Methods Used in Modern Cyanide Mills. Clyde H. Jay. (West. Chem. and Met., May, 1908; 8 pp.) An article which gives information, most of which may be found in text books or papers, in such a concise and compact form that it will greatly aid the young engineer in readily taking up the work required in the laboratory of a cyanide mill. 60c.

6644—CYANIDATION—The Separation of Slime in Cyanide Treatment. Horace G. Nichols. (Min. and Sci. Press, April 25, 1908; 3½ pp.) Describes a process which first suggested itself in connection with the dewatering of tailing at a property in Central America; accompanied by sketches. 20c.

6645—CYANIDATION—Laboratory Tests on the Use of Coarse and Fine Lime for Cyaniding. W. J. Sharwood. (Journ. Chem. Met. and Min. Soc. of South Africa, April, 1908; 4½ pp.) Experiments to ascertain the rapidity with which commercial lime in various states of division would be dissolved when distributed through a charge of inert sand subjected to the action of percolating water or cyanide solution. 60c.

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6647—ELECTRICAL EQUIPMENT of Gold Mines. H. J. S. Heather. (Inst. of Min. and Met., April 2, 1908; 15½ pp.) The transmission and distribution of electric power is described in connection with the electrical equipment of gold mines.

6648—GUANAJUATO—Résumé of Mine Operations for Six Months. (Mexican Min. Journ., June, 1908; ¾ p.) Some interesting facts and figures taken from the recent report of the Governor of Guanajuato to the State Legislature. 20c.

6649—HOMESTAKE MINE—Beneficio de minerales de Oro. I. D. Osso. (Boletin de la Soc. Nac. de Mineria, Feb., 1908; 10 pp.) Describes in great detail the operations and the results attained at the Homestake mine, South Dakota.

6650—KLONDIKE GRAVEL DEPOSITS—Report on Gold Values in the Klondike High Level Gravels. R. G. McConnell. (Geol. Surv. of Can., 1908; 34 pp., 1 map.) This report deals principally with the value still remaining in the bench and creek gravels, and especially in the important high level deposits known as the white Channel gravel.

6651—MEXICAN NOTES. Mark R. Lamb. (Min. and Sci. Press, May 23 and 30, 1908; 4½ pp.) A general discussion of conditions in silver mining, showing the contrast between the old and new arrangements of treatment plants; illustrated. 40c.

6652—MEXICO—The Ore Deposits of Santa Eulalia, Mexico. Claude T. Rice. (Eng. and Min. Journ., June 20, 1908; 4 1/3 pp. The occurrence in *mantas* and *abras*, and the prevalence of large open caves, is characteristic of this district in Chihuahua. The article describes this old Mexican district and is the result of the author's observations made recently. Illustrated. 20c.

6653 — MICROSCOPIC ANALYSIS. A Method of Analysis in Roasting Sulpho-Telluride Ores. William H. Davis. (West. Chem. and Met., May, 1908; 11 pp.) Describes the microscope work done at the Wano mine, near the northern boundary of the Boulder county telluride belt, about 45 miles northwest of Denver, Colo., where there is in operation a 50-ton dry-crushing, ronsting, cyanide mill. 60c.

6654—MONTANA—Gold Deposits of the Little Rocky Mountains, Montana. William H. Emmons. (Geol. Surv., Bull. 340-A, 1908; 20 1-3 pp.) Goes into the history of development, geology, ore deposits, character of the ore, and gives a detailed description of some of the mines.

6655—NEVADA—Round Mountain, Nevada. George A. Packard. (Min. and Sci. Press, June 13, 1908; 2 pp.) Describes the geology and ore occurrence at this Nevada camp. 20c.

6656—NEVADA—Geology and Mineral Resources of the Osceola Mining District, White Pine County, Nev. F. B. Weeks, (Geol. Surv., Bull. 340-A, 1908; 16¼ pp.) Contains a

general description of the Snake range, and goes into the physical features, general geology, history of development, mining, genesis of the ore and distribution of the mines in the Osdeola mining district.

6657 — NEVADA — Goldfield, Nevada — I. T. A. Rickard. (Min. and Sci. Press, April 25, 1908; 3 1/3 pp.) Contains many interesting facts about the early history of Goldfield. 20c.

6658—NEVADA—Goldfield, Nevada—II. T. A. Rickard. (Min. and Sci. Press, May 16, 1908; 3¾ pp.) Gives some historical data on the growth of Goldfield in which George Wingfield is the central figure. 20c.

6659—NEVADA—Goldfield, Nevada — III. T. A. Rickard. (Min. and Sci. Press, May 30, 1908; 4½ pp.) This number goes into the different scientific investigations of the district and discusses its geology; illustrated. 20c.

6660—NEVADA—Goldfield, Nevada — IV. T. A. Rickard. (Min. and Sci. Press, June 6, 1908; 3½ pp.) This is the fourth instalment of the article on Goldfield and its riches. It treats of the fabulously rich ore which has been found in this district, and the prevalence of "high grading." 20c.

6661—OREGON—Mines of the Riddles Quadrangle, Oregon. J. S. Diller aand G. F. Kay. (Geol. Survey Bull. 340-A, 1908; 3½ pp.) Discusses the geology and ore deposits and describes some of the principal mines.

6662—PLACER MINING—Constructing a Placer Sluice. Dennis H. Stovall. (Min. Sci. June 11, 1908; ¾ p.) The method of building sluices for placer mines is described and illustrated by a photograph. 20c.

6663—RAND MINING — Present Mining Conditions on the Rand. Thomas H. Leggett. (Bi-Monthly Bull. A. I. M. E., May, 1908; 14 pp.) A comprehensive view of the industry and its surroundings as a whole, marking its general development and the lines of its future progress. An abstract of this paper is contained in the JOURNAL of June 20, 1908.

6664—SIBERIA—Kupfer-, Silber- und Goldgewinnung im Altai. F. Thiess. (Zeit. des Oberschlesischen B.- u. Hüttenm. Vereins, Apr., 1908; 8 pp.) Abstract of a chapter in a Russian publication giving an historical review of the gold, silver and copper industries of Altai, Western Siberia.

6665—SILVER PRODUCTION—A Geological Analysis of the Silver Production of the United States in 1906. Waldemar Lindgren. (Geol. Surv., Bull. 340-A, 1908; 13 pp.) Goes into general geological conditions and discusses the output of ores according to their classification into silver-base metal ores, silicious silver ores, silver-lead-copper ores, silver-gold ores, and silver ores.

6666—STAMP MILLING—A Few Notes on Stamp Milling. W. H. Jane. (Journ. Chem. Met. and Min. Soc. of South Africa, April, 1908; 1 p.) Briefly discusses the operation and theory of the stamp battery. 60c.

6667—STATISTICS—Die Statistik der Edelmetalle als Material zur Beurteilung wirtschaftlicher Fragen. Ernst. Biedermann. (Zeit. f. B. H. u. S-wesen, 1908, 1 Heft; 108 pp., 3 plates.) A very detailed and exhaustive discussion of the world's production, exchange and consumption of gold and silver, illustrated with numerous diagrams and tables. It discusses the relative values of the two metals, the influence of production upon prices, the consumption of the metals for industrial purposes, etc. $1.

6668—TUBE MILLING—The Economics of Tube Milling. H. W. Fox. (Mines and Min., June, 1908; 4 pp.) Sets forth experiments showing the relation between the amount of ore, pebbles, and solution and the amount of power consumed; contains interesting charts and tables. 20c.

6669—YUKON GOLD. O. B. Perry. (Min. and Sci. Press, April 25, 1908; 1½ pp.) A letter containing some remarks and figures regarding operations of the Yukon Gold Company; also editorial comment. 20c.

GYPSUM

6670—MONTANA—Gypsum Deposits of Montana. J. P. Rowe. (Eng. and Min. Journ., June 20, 1908; 2 pp.) A description of the three gypsum fields of Montana. This State has as large gypsum resources as any State in the Union. Illustrated. 20c.

IRON AND STEEL

6671—ALABAMA—The Brown Iron Ore Deposits of Alabama-I. and II. William B. Phillips. (Iron Age, June 4 and 11, 1908; 6 pp.) The first instalment is devoted entirely to the geology of the Alabama Iron fields. The second part deals with the production for a period of years and contains some remarks relative to the future production. 40c.

6672—ALABAMA—The Iron Ore Industry in Alabama. Eugene A. Smith. (Eng. and Min. Journ., June 6, 1908; ¾ p.) Describes the principal ores of iron, their occurrence and utilization. 20c.

6673—ALLOYS—New Steel Alloys. (Mech. Eng., June 5, 1908; ¾ p.) A particularly tough and hard metal, having a high tensile strength and with little susceptibility to injury from shock or impact, consists of a combination of nickel, titanium, manganese, and chromium, with iron or steel of various carbon contents. 20c.

6674—ANNEALING—Novel Air and Annealing Furnaces. (Foundry, June, 1908; 3½ pp.) Describes the furnaces in use at the new plant of the Allegheny Valley Malleable Iron Company, New Kensington, Penn., by which the time of making heats and annealing the castings is reduced to three days; illustrated. 20c.

6675—BASIC BESSEMER PROCESS—The Flohr Improvement of the Basic Bessemer Process. (Iron Age, May 28, 1908; 1p.) In this method the temperature during decarbonizing is higher than during the dephosphorizing stage in the basic bessemer converter. 20c.

6676—BASIC STEEL—Das Düdelinger Verfahren zur Durchführung des Thomasprozesses. P. Goerens. (Stahl u. Eisen, May 13, 1908; 4½ pp.) Discusses a number of recent developments in the Thomas open hearth process. 40c.

6677—BLAST FURNACE—Zur Berechnung und Profilierung der Eisenhochöfen. J. von Ehrenwerth. (Oest. Zeit. f. B. u. H., May 9, 1908; 4½ pp.) Discusses the effect of furnace profile upon the smelting reactions, with reference to its design under given conditions. 40c.

6678—BLAST FURNACE CALCULATIONS. S. J. Koshkin. (Iron Age, May 28, 1908; 4¾ pp.) Describes the method of calculating a blast furnace charge, together with the formation of the slag. The blast and escaping gases are also considered. 20c.

6679—BLAST FURNACE FUELS—Charcoal and Coke as Blast-Furnace Fuels. R. H. Sweetser. (Bi-Monthly Bull., A. I. M. E., May, 1908; 7½ pp.) Describes the furnaces and gives the data of comparative runs made with charcoal and coke at the works of the Algoma Steel Company, Sault Ste. Marie, Ontario.

6680—BLAST FURNACE IMPROVEMENTS—Ueber neuere Hochofenbegichtungen. O. Simmersbach. (Stahl u. Eisen, May 6 and 13, 1908; 10 pp.) Describes and illustrates a number of recent improvements in German blast furnaces, especially in connection with charging devices. 60c.

6681—BLAST FURNACE SLAG—The Manufacture of Cement and Bricks from Blast-Furnace Slag. C. C. de Schwarz. (Eng. Rev., June, 1908; 7 pp.; Iron and Coal Tr. Rev., May 15, 1908; 1½ pp.) Contains the history of the manufacture of cement and bricks from blast-furnace slag and the utilization of such slag for manufacturing cement. The article contains description of the various processes employed in such work. Paper before the Iron and Steel Institute. 40c.

6682—BOILER HOUSE—The Standard Boiler House of the Oliver Iron Mining Co. A. M. Gow. (Proc. Lake Superior Min. Inst., June, 1908; 15 pp. 8 plates.) The standard boiler house of the Oliver Iron Mining Company is treated under the head of the boiler; the boiler setting; the fronts and appurtenances; the stack and breeching; the building, coal trestle and elevator; costs. The article contains a full set of working drawings reduced to a convenient size.

6683—CANADA—The Iron Ores of Canada. C. K. Leith. (Econ. Geol., June-July, 1908; 15½ pp.) The classification of iron-ore deposits in Canada is based upon recent detailed studies of the Lake Superior ores and ores of Western United States. Describes the various types, together with the commercial importance of several classes of ores. 60c.

6684—CARBON AND SULPHUR IN IRON—Iron, Carbon and Sulphur. Donald M. Levy. and Coal Tr. Rev., May 15, 1908; 1 1/3 pp.) Supplements previous research work by a complete thermal and metallographic investigation of the subject. 40c.

6685—CAR WHEELS—The Chilled Cast Iron Car Wheel. P. H. Griffin. (Iron Age, June 4, 1908; 2¼ pp.) The difficulties with which the manufacturer has to contend, the small margin of price between new and old wheels, mixtures, chills, and other considerations are discussed. 20c.

6686—CASE-HARDENING—The Gas Process of Case-Hardening. J. F. Springer. (Iron Age, May 28, 1908; 4¼ pp.) A description of the method of case-hardening developed by Adolf W. Matschlep, superintendent of the American Gas Furnace Company, Elizabeth, N. J.; illustrated. 20c.

6687—CAST STEEL—Herstellung und Verwendung von Stahlguss. (Eisen-Zeitg., May 23, 1908; 2 pp.) Discusses the cost of manufacturing cast steel. 40c.

6688—CAST IRON in the Construction of Chemical Plant. F. J. R. Carulla. (Iron and Coal Tr. Rev., May 15, 1908; 1 1-3 pp.) Lays down some simple rules on the use of cast iron, a substance that the chemical manufacturer cannot well do without. 40c.

6689—CASTING PIPES in Permanent Molds. Edgar A. Custer. (Journ. Frank Inst., June, 1908; 20½ pp.) Describes methods and apparatus for casting pipes in permanent molds which are not destroyed by molten iron and which alleviates unequal heating and cooling; illustrated. 60c.

6690—CHROMIUM-STEEL—Ein neuer Chromwerkzeugstahl. (Centralblatt der H. u. Walzwerke, May 15, 1908; ½ p.) Describes a new chromium tool-steel made in the electric furnace. 20c.

6691—COATING IRON WITH ZINC—The Deposition of Zinc for the Protection of Iron and Steel Surfaces. Sherard Cowper-Coles. (Iron and Coal Tr. Rev., May 15, 1908; 5½ pp.) Outlines and discusses the four methods used at present for applying zinc to iron and steel; illustrated. 40c.

6692—COLORADO—Die Colorado Fuel and Iron Company. F. Frölich. (Zeit. des Vereines Deutscher Ingenieure, May 9, 1908; 6 pp.) Describes the plant in some detail, discusses its operation and enumerates the sources of its crude materials. 40c.

6693—CORROSION—The Rusting of Iron. J. Newton Friend. (Iron and Coal Tr. Rev., May 15, 1908; ¾ p.) Gives and explains several theories why iron corrodes when exposed to the combined action of the air and water. 40c.

6694—CORROSION—Methods for Protecting Iron and Steel Against Corrosion. Geo. B. Heckel. (Journ. Frank. Inst., June, 1908; 15 pp.) A general discussion on this subject with a review of the work which has been done in connection with it. 60c.

6695—CUPOLA PRACTICE—Kupolofenbetrieb in Amerika. O. Leyde. (Stahl u. Eisen, May 20, 1908; 5½ pp.) A discussion of cupola furnace practice in the United States, quoting largely from American authorities. 40c.

6696—DUPLEX STEEL PROCESS at Ensley, Alabama. (Iron Age, May 21, 1908; 18 pp.) The new Ensley bessemer and open-hearth plants of the Tennessee Coal, Iron and Railroad Company and the connected blast furnaces are described in great detail. The article contains many working drawings and reproductions of photographs. 20c.

6697—ELECTRIC FURNACE—Der Elektrische Ofen von Ischewski. B. Neumann (Stahl u. Eisen, May 20, 1908; 1½ pp.) Illustrates a revolving electric furnace for continuous operation. 40c.

6698—ELECTRIC FURNACE—New Type of Furnace for Smelting Iron. B. Igewsky. (Mech. Eng., June 5, 1908; 2½ pp.) Iron and Coal Tr. Rev., May 15, 1908; 1½ pp.) Description of a rotating electric furnace in which a high voltage is used. Paper read before the Iron and Steel Institute. 40c.

6699—ELECTRIC FURNACE—Stahlformguss aus dem elektrischen Ofen. B. Osann. (Mech. Eng., June 5, 1908; 2½ pp.; Iron lustrates a number of castings poured from the Steffans electric furnace, describes the arrangement of the furnace, and itemizes its cost of operation. 40c.

6700—ELECTRIC IRON AND STEEL FURNACES. (Engineering, June 5, 1908; 2½ pp.) A comparison of the Héroult, Keller, Gin, Harmet, and various other electric furnaces is given in the first instalment. To be continued. 40c.

6701—ELECTRIC STEEL—Commercial Electric Steel and Gas Power. (Electrochem. and Met. Ind., June, 1908; 1⅜ pp.) Tells what the electric furnace can do in steel manufacture; contains a table which shows what is actually being done at a plant now in commercial operation. 40c.

6702 — ELECTRICALLY-DRIVEN MERCHANT IRON MILL at the Westfaelische Stahlwerke. (Iron and Coal Tr. Rev., May 15, 1908; 1¼ pp.) Describes the units and working method of a modern mill of large output, provided as far as possible with automatic auxiliary machinery. 40c.

6703—ELECTRICAL EQUIPMENT of the Cargo Fleet Iron Co.'s Works. (Iron Tr. Rev., June 4, 1908; 5 pp.) Treats of the use of electric motors in iron and steel works. Describes the installation at the Cargo Fleet Iron Company's plant in England. 20c.

6704—ELECTRO-METALLURGY of Iron, Cast Iron and Steel in Mexico. Francis Louvrier. (Min. Journ., May 30, 1908; 1 p.) A review of the conditions in the iron ore industry in Mexico, pointing out the advantages and economy of treating the ore in the electric furnace. 40c.

6705—EQUIPMENT—The New Equipment at the Newport Mine. (Iron Tr. Rev., June 18, 1908; 9 pp.) The new shaft "D" has just been completed and supersedes the old shaft "A." A description of this shaft is given and illustrated by drawings and photographs. 20c.

6706—FATIGUE TEST—A New Fatigue Test for Iron and Steel. T. E. Stanton. (Iron and Coal Tr. Rev., May 15, 1908; 1½ pp.) Outlines a test which gives a combination of rolling abrasion and alternate tending; fully illustrated. Paper read before the Iron and Steel Institute. 40c.

6707—FOUNDRY—Problems Involved in the Erection and Equipment of a Modern Foundry. W. T. Hatch. (Foundry, June, 1908; 3 pp.) Discusses the many questions, general in character, which must be considered in building and fitting up a modern foundry. 20c.

6708—FRANCE—Le Minerai de Fer dans l'Ouest de la France. L. Campredon. (Metallurgie, May 20, 1908; ½ p.) Describes the occurrence of iron ores in some of the western districts of France. 40c.

6709—GALVANIZED IRON PIPE—Notes on the Action of Water on Galvanized Iron. W. F. Monfort. (Can. Eng., June 5, 1908; 1 p.) Treats of the action of a partially softened water upon the zinc coating of galvanized iron pipe as affecting their durability. 20c.

6710 — GAS INCLUSIONS — Gaz Occlus dans les Aciers. G. Belloc. (Bull. de la Soc. d'Enc. pour l'Ind. Nat., April, 1908; 25 pp.) Describes the apparatus and method used, and gives detailed results of a series of careful experiments into the nature of the gases included in steel and into the conditions under which they are absorbed and given off.

6711—INGOTS—Piping and Segregation in Steel Ingots. (Bi-monthly Bull, A. I. M. E., May, 1908; 29 pp.) Discussion by members of the Institute of Prof. H. M. Howe's paper on the above subject, which was previously mentioned in this Index.

6712—IRON-WORKS LABORATORIES—Zur Organisation moderner Eisenhüttenlaboratorien. A. Wencelius. (Stahl u. Eisen, May 13, 1908; 3½ pp.) Describes the plan, equipment and management of the modern laboratory for iron works. To be concluded. 40c.

6713—LAKE SUPERIOR—Kohle und Eisen in Nordamerika. Prof. Baum. (Glückauf, May 9 and 16, 1908; 12 pp.) Continuation of article previously indexed. This section describes the mining and shipping methods in use on the Lake Superior ranges. 60c.

6714—MALLEABLE CAST IRON—Temperguss in Amerika. C. Geiger. (Stahl u. Eisen, May 13, 1908; 1 p.) Compares the properties of malleable castings made in different ways. 40c.

6715—MALLEABLE CASTINGS—Production of Malleable Castings—V. Richard Moldenke. (Foundry, June, 1908; 2 pp.) A continuation of this article, discussing mixtures for making various grades of malleables and methods of calculating the furnace charges. 20c.

6716—NEW YORK—Future Adirondack Iron. George F. Archer. (Sibley Journ. Eng., June, 1908; 1¼ pp.) Describes the geology of this district and some of the more important mines. Goes briefly into the possibilities of the future for this Adirondack mountain district; illustrated. 40c.

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Soc. of Nova Scotia, Vol. XI, 1908; 17½ pp.) Goes into the history of salt, its origin, some of its principal occurrences, with a description of some of the methods of manufacture.

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6762—CANADA—A Partial Bibliography of Publications Referring to the Geology and Mineral Resources of Alberta, British Columbia and the Yukon. J. C. Gwillim. (Can. Min. Journ., June 1, 1908; 2 pp.) A continuation of this bibliography. 20c.

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6799—SHAFT SINKING—Methods of Shaft Sinking. (Iron and Coal Tr. Rev., May 22, 1908; 1¾ pp.) Describes the Kind-Chaudron method, the freezing process, sinking by means of drop shafts, and subaqueous sinking by means of sackborers, and gives the application of the diffeent methods; illustrated. 40c.

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6801—STREAM DIVERSION—Methods and Cost of Building a Concrete-Steel Culvert to Carry an Irrigation Canal Under a Creek Bed. Henry A. Young. (Eng. Con., June 10, 1908; 1 1/3 pp.) The data in this article should be valuable to the mining engineer who is confronted with the problem of diverting a stream. 20c.

6802—STREAM DIVERSION—Diverting the Rivers at the Loretto Mine. (Iron Tr. Rev., June 18, 1908; 3¾ pp.) An interesting and unusual engineering undertaking at the Loretto mine on the east end of the Menominee range. By diverting the course of the Sturgeon river the mine workings were made safe. Illustrated. 20c.

6803—TASMANIA—Mining in Zeehan Silver-Lead Field, Tasmania. Ralph Stokes. (Min. Wld., June 6, 1908; 2½ pp.) Mentions the discovery of galena and its effect upon stock speculation; goes into the geology of the silver-lead deposits, and also into industrial conditions; illustrated. 20c.

6804—TIMBERING—Mine Methods and Timbering. W. H. Storms. (Am. Min. Rev., June 6, 1908; 1¼ pp.) The necessity and usefulness of bearers in shafts; how they are placed; methods of framing. Illustrated by drawings. To be continued. 20c.

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6806—TIMBERING—Steel Supports for Mine Drifts. R. B. Woodworth. (Eng. and Min. Journ., June 13, 1908; 1 1/3 pp.) An improved form of steel support for mine drifts is described and illustrated with drawings. Abstract of a paper in Proc. Eng. Soc. of W. Penn. 20c.

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6808—TUNNEL LININGS—Streckenausbau mittels Eisenbeton. W. Stark. (Glückauf. May 9, 1908; 2 pp.) Describes the methods of lining a coal mine entry in Germany with reinforced concrete. 40c.

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6810—WASHINGTON—The Lake Chelan Country. S. G. Dewsnap. (Northwest Min. Journ., May, 1908; 2 pp.) Briefly describes the mineral resources of this Washington district. 20c.

6811—WEST AUSTRALIA MINING PRACTICE—VI. E. Davenport Cleland. (Monthly Journ. Chamber of Mines of W. A., Mar. 31, 1908; 19 pp.) A complete illustrated description of the methods of stoping and timbering and the costs of the same. 80c.

ORE DRESSING

6812—CRUSHING—Ore Reduction Practice, W. A. (Aust. Min. Stand., May 6, 1908; ¾ p.) The article discusses the various conditions influencing the selection of rock crushers. 40c.

6813—SULPHIDE ORE TREATMENT—Dressing Sulphide Ores. E. B. Wilson. (Mines and Min., June, 1908; 1¼ pp.) Gives some causes for poor results in concentration and points out the importance of adapting the methods of treatment to the peculiarities of the ores. 20c.

METALLURGY—GENERAL

6814—ELECTRIC CONDUCTIVITY OF METALS—Folgerungen für die Technik aus dem heutigen Stande unserer Erkenntnis des elektischen Leitungswidestandes der Metallegierungen. W. Guertler. (Metallurgie, May 22, 1908; 4 pp.) Discusses the relative conductivity of several metals and their alloys. 40c.

6815—LABORATORIES—The Metallurgical and Chemical Laboratories in the National Physical Laboratory. Walter Rosenhain. (Iron and Coal Tr. Rev., May 15, 1908; 3 pp.) An account of the present state of the department with special regard to the work which is either in hand or which the department is capable of undertaking. Paper read before the Iron and Steel Institute. 40c.

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